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Do you wait for hot water on a cold Monday morning?

Where hot water is provided from a storage system there is a waiting period when production starts, for the water to heat up in the storage tanks.
With Leonard Steam Water Mixers there is no waiting period. Hot water is available as soon as the steam is turned on.

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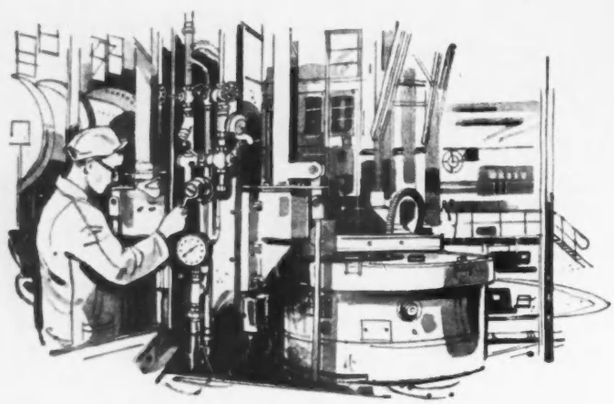
When vegetables are cleaned for canning they are washed in a running stream of water. If the water is too cold the girls' fingers get numb and their production slows down. If it is too hot the vegetables are spoilt. A Leonard Valve looks after the temperature, the girls' fingers and the vegetables.

How would you raise the temperature of a spray very gradually from cold to 120 degrees?

Leonard Valves fitted to the sparge pipe on a cloth scouring and milling machine enable the scourer to vary the temperature to suit the work and to make changes in the temperature during the process gradually, giving a cleaner scour and a better finish.



These are specific examples. Your use of Leonard Thermostatic Steam Water Heaters will probably be different. Write for help. (Our folder H 6)

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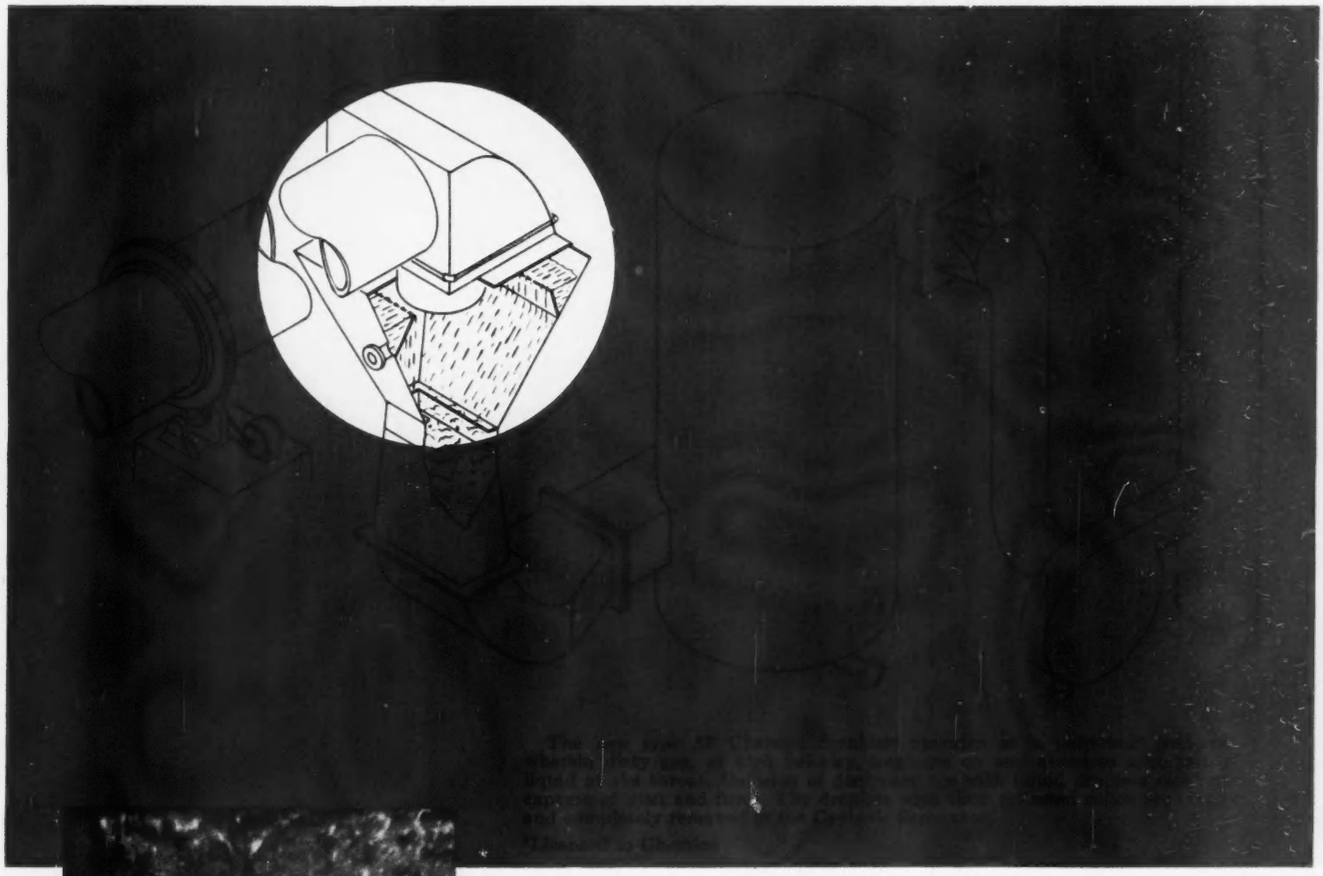

Actual photograph of throat action

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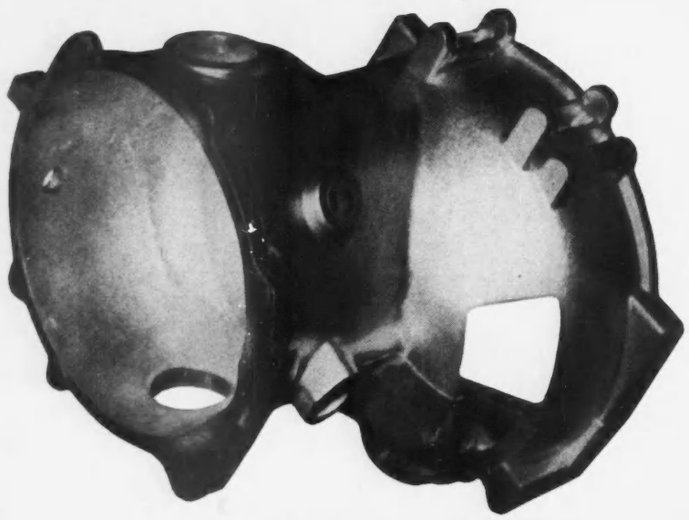

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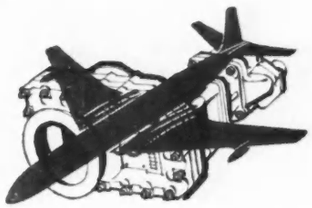

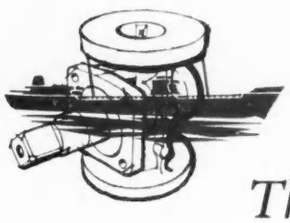

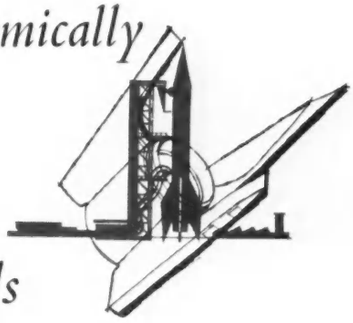

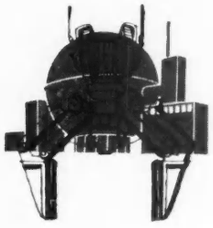

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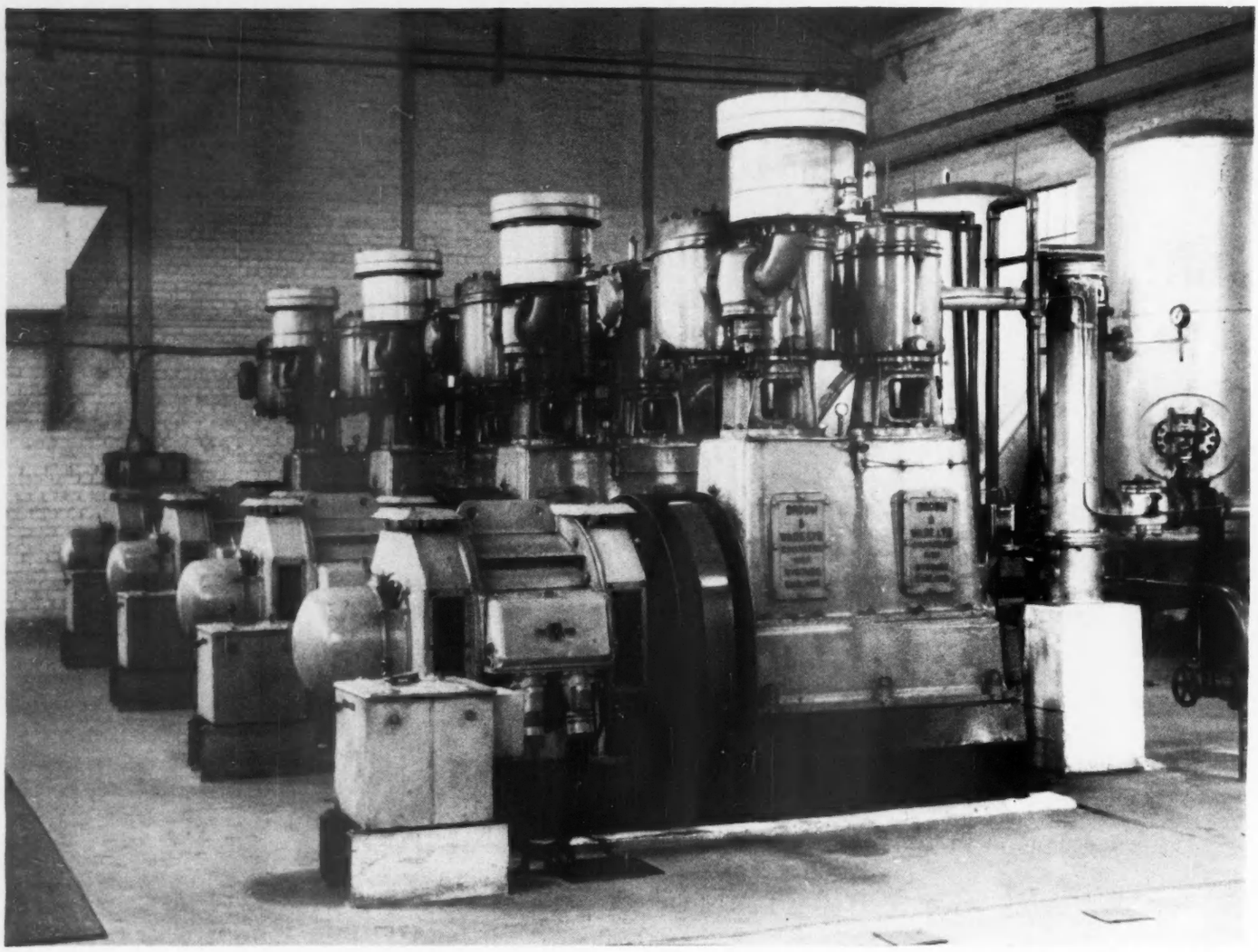

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10 June 1960

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Founded in 1866

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Assembly of an eight-day alarm clock: the electronic timing device is being combined with the dial and the ancillary winding knobs. (*Nurnberg photograph for* ENGINEERING)

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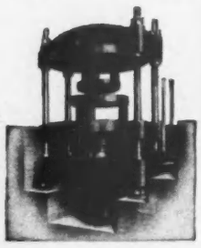

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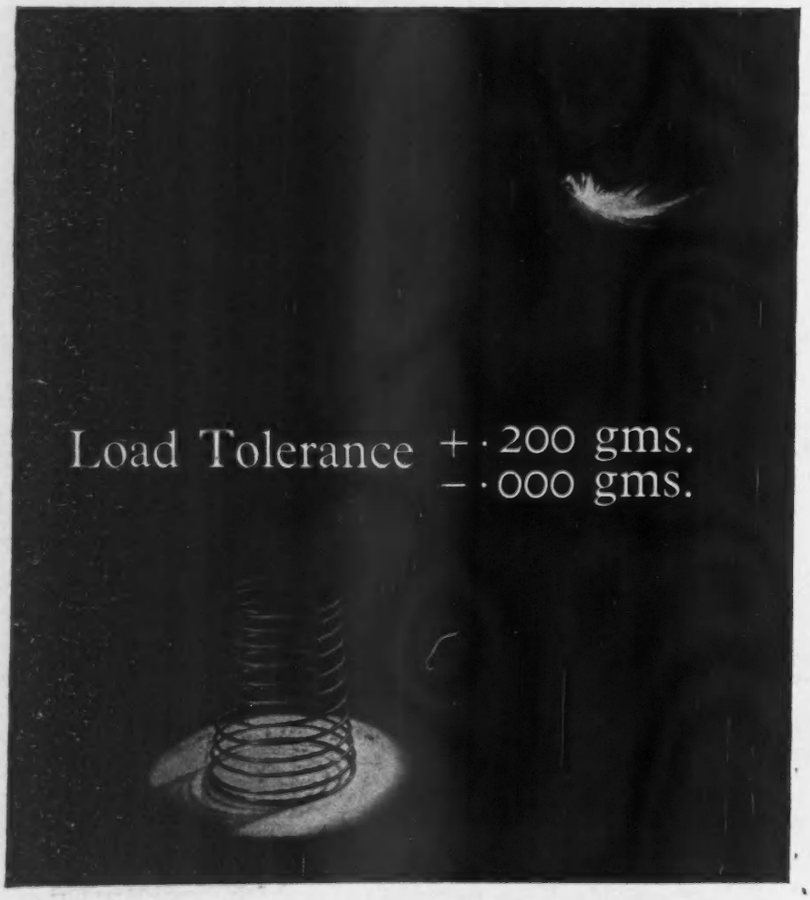

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CORPORATION WATERWORKS

LLANDEGFEDD WATER SCHEME—SECTION B.

CONTRACT NO. B.2

PLANT AT USK AND SOR PUMPING STATIONS

TENDERS are invited for the supply and erection of Pumps, Motors, Switchgear, Screens and other electrical and mechanical plant for the complete equipment of two Pumping Stations; one near the town of USK and the other near the town of PONTYPOOL, both in Monmouthshire.

Drawings, Specifications, Schedule of Prices and Form of Tender may be obtained from the ENGINEER, ENGINEER'S OFFICE, SLUVAD, PANTEG, NEAR PONTYPOOL, MON., to whom application should be made accompanied by a deposit of £3 3s. 0d. Cheques should be made payable to Cardiff Corporation and crossed "Not Negotiable & Co." The deposit will be refunded upon receipt of a *bona fide* Tender, or the return of the contract documents.

Tenderers must also submit with their Tenders particulars of works, similar in character, carried out by them.

Tenders must be submitted, on the form which will be provided, duly completed and sealed with the Conditions of Tender in a small envelope marked on the outside only with the words "Tender for Llandegfedd Water Scheme—Section 'B,' Contract No. B.2—Plant at Usk and Sor Pumping Stations."

A fully priced Schedule of Prices and any documents loaned by the Corporation for the purpose of submitting a Tender, and any drawings submitted with the Tender, must be sealed up in a separate large envelope, marked on the outside only with the name of the firm submitting the Tender.

Both these envelopes must be enclosed in the third sealed envelope marked on the outside only with the words "Tender for Llandegfedd Water Scheme—Section 'B,'—Contract No. B.2—Plant at Usk and Sor Pumping Stations," addressed to the UNDERSIGNED and sent by REGISTERED POST so as to be received not later than 13th SEPTEMBER, 1960.

The Corporation does not bind itself to accept the lowest or any Tender.

S. TAPPER-JONES,
TOWN CLERK,
CITY HALL,
CARDIFF.
JUNE, 1960. C 296

DIRECTOR GENERAL, INDIA STORE DEPARTMENT, GOVERNMENT BUILDING, BROMYARD AVENUE, ACTON, W.3, invites Tenders for the supply of:—

TENDER REF. 21001/60/BMB/HAL.3

"C.M. STEEL TUBES TO T 35-T 45 B.S. (AIRCRAFT) SPECIFICATIONS, ½ in. O.D. to 4½ in. O.D., VARIOUS GAUGES IN LARGE QUANTITIES."

The tender forms with schedules and specifications which are returnable on 7th JULY, 1960, may be obtained from the above office on payment of a fee of 10s. (not refundable) for each tender.

Applications for tender should specify the above reference. C 302

THE REPUBLIC OF THE SUDAN

MINISTRY OF IRRIGATION AND HYDRO-ELECTRIC POWER

ROSEIRES DAM AND ASSOCIATED WORKS

The Ministry of Irrigation and Hydro-Electric Power of the Republic of the Sudan propose to call for TENDERS for the main Civil Engineering and Associated Works of the Roseires Dam scheme in the vicinity of the Damazin Rapids on the Blue Nile. The site is about 5½ kilometres upstream of the town of Roseires, approximately 500 kilometers south of Khartoum.

The main Civil Engineering Works will comprise the construction of a heavy buttress concrete dam across the river channel, with earth dams on either flanks, together with control gates and other equipment. The concrete dam will have a length of 1,110 metres and a maximum height of 60 metres above river bed level. The length of the earth embankments will be approximately 8 kilometres.

The Associated Works will comprise the construction of permanent and temporary housing with roads and services, together with an airstrip as well as a road bridge across the river.

ASSOCIATED WORKS

(1) A preliminary document and drawings outlining the work involved will be available for issue now.

(2) Contractors who may be interested in tendering for the Associated Works should submit full details of their qualifications and experience as soon as possible and not later than JUNE 20th, 1960, to enable tender documents and drawings to be issued in JULY, 1960, to those Contractors who satisfy the requirements of the Ministry.

Work will have to be started in NOVEMBER, 1960

MAIN CIVIL ENGINEERING WORKS

ALTHOUGH THE GOVERNMENT OF THE SUDAN ARE NOT YET ABLE TO ENTER INTO ANY DEFINITE COMMITMENT, IT IS HOPED THAT THE MAIN CIVIL ENGINEERING WORKS WILL COMMENCE ABOUT NOVEMBER 1961.

A preliminary document and drawings outlining the work involved will be available for issue now.

Contractors who may be interested in tendering for the Main Civil Engineering Works should submit full details of their qualifications and experience as soon as possible, and not later than JULY 15th, 1960, to enable tender documents and drawings to be issued in JANUARY, 1961, to Contractors who satisfy the requirements of the Ministry, ALWAYS PROVIDED THAT THE GOVERNMENT HAS FINALLY DECIDED TO PROCEED WITH THE WORKS IN NOVEMBER 1961.

The Joint Consulting Engineers to the Ministry on this project are:

Sir Alexander Gibb & Partners, Queen Anne's Lodge, Westminster, London, S.W.1.
and MM. Andre Coyne et Jean Bellier, 19 Rue Alphonse de Neuville, Paris, XVII.

Applications for the preliminary document by *bona fide* firms should be made to the following, with a copy to the Consulting Engineers:—

THE MINISTRY OF IRRIGATION AND HYDRO-ELECTRIC POWER,
THE REPUBLIC OF THE SUDAN,
P.O. BOX NO. 878,
KHARTOUM, THE SOUDAN

Applications received after the dates specified above might not be considered. C 273

ELECTRICITY CORPORATION OF NIGERIA

INVITATION TO TENDER

HIGH VOLTAGE SWITCHBOARD

THE ELECTRICITY CORPORATION OF NIGERIA invites TENDERS for the Supply c. and f. Port-Harcourt of:—

ONE NO. 8 PANEL 250 MVA SWITCHBOARD INSULATED FOR OPERATION ON AN 11,000 VOLT SYSTEM.

Tender documents giving further details of the Contract may be obtained from the RESIDENT ENGINEER, ELECTRICITY CORPORATION OF NIGERIA, ADELPHI, JOHN ADAM STREET, LONDON, W.C.2.

Each Tender must be enclosed in a sealed envelope marked "Confidential—Tender for Supply of High Voltage Switchboard—Port-Harcourt," and must be received at the Office of THE SECRETARY, ELECTRICITY CORPORATION OF NIGERIA, 13, BROAD STREET, PRIVATE MAIL BAG 2030, LAGOS, NIGERIA, WEST AFRICA, not later than noon on 2nd JULY, 1960. Tenders received in any other manner will not be considered.

The Electricity Corporation of Nigeria does not undertake to accept the lowest or any Tender.

Further information concerning this Contract may be obtained on application to the Resident Engineer.

GEORGE W. NICOL,
ACTING SECRETARY TO THE CORPORATION C 283

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"FOR THE SUPPLY OF 590 CWTS. OF 2½ IN. TO 3 IN. STUD LINK, WROUGHT IRON, PENDANT CHAIN."

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All cranes suitable for electric supply 400/440 volts 3 phase, 50 cycles.

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BESCO OPEN END GUILLOTINE SHEARING MACHINE. Motorised for 380-420/3/50 supply. Capacity 36½ by ½ in. mild steel. Complete with front, back and side gauges, and automatic sheet hold-down. Weight approximately 20 cwt.

TWO NEW BESCO TYPE F. 90½ IN. BY 15 S.W.G. UNIVERSAL SWING BEAM FOLDING MACHINES, with high lift clamping beam and adjustable bed. Maximum working length 80½ in. Capacity mild steel 14 S.W.G.

PELS DOUBLE ENDED ANGLE AND TEE IRON CROPPING MACHINE. Motorised for 400-440/3/50 supply. Crops angles 7 in. by 7 in. by ½ in. Tees 6½ in. by 6½ in. by ½ in. Weight approximately 75 cwt.

NEW STOELTING PLATE BENDING ROLLER. Motorised for 400-440/3/50 supply. Capacity 10 ft. by ½ in. Diameter of top roll 9⅝ in. Bottom rolls 7⅝ in. Rolling speed approximately 16 ft. per minute. Weight approximately 91 cwt.

CRAIG & DONALD ROTARY SHEARING MACHINE. Motorised for 400-440/3/50 supply. Capacity mild steel ⅜ in. thickness. Depth of gap 30 in. Diameter of cutters 3½ in. Weight approximately 36 cwt.

NEW BESCO POWER OPERATED DOUBLE GEARED SWING BEAM ANGLE BENDING MACHINE. Undercrank type. Arranged motor drive for 380-420/3/50. Smallest trunk that can be formed over beam 36 in. long by 12 in. square. Capacity, mild steel 4 ft. by ⅜ in. Stroke 2½ in. Treadle operated clutch. Weight approximately 3 tons.

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ALBION WORKS SHEFFIELD
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For 'Engineering' Appointments Section, turn to the centre of editorial section. B2

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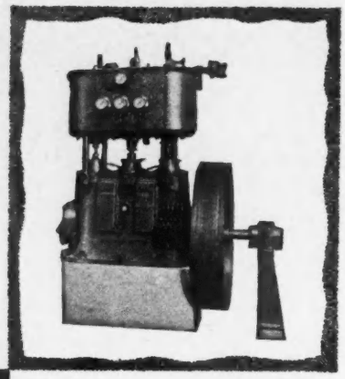

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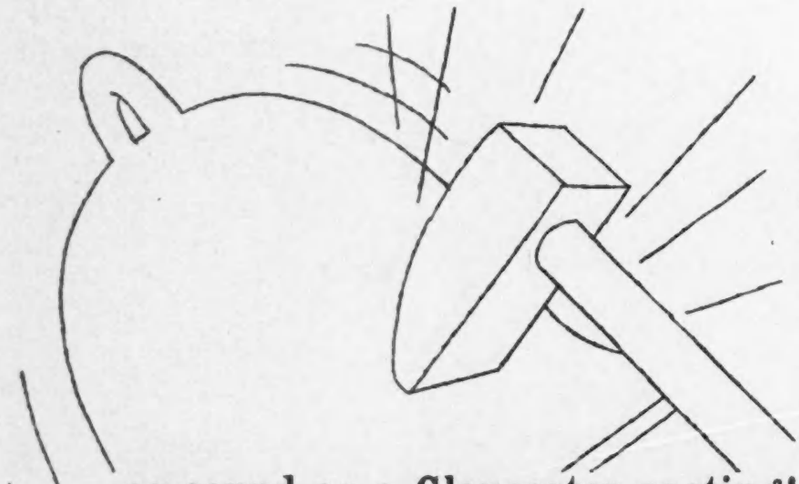

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A typical Gloucester Malleable specification.

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Elongation	18%	Elongation	5%
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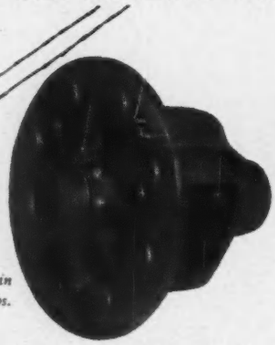

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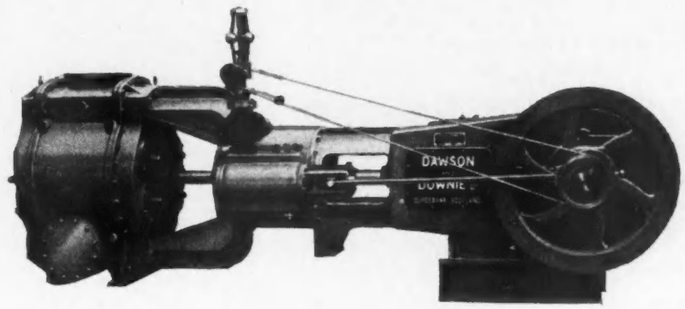

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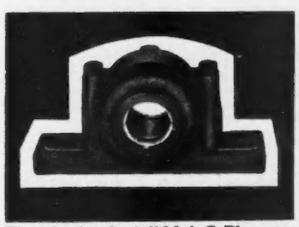
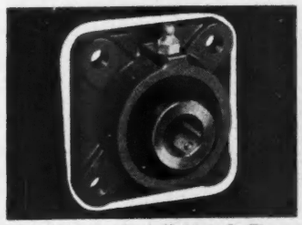


The "Auchterlonie" M.A.C. Plummer Block is fitted with double-row self-aligning adapter ball bearings.

The "Auchterlonie" WEB Pattern Plummer Block has standard double-row self-aligning ball bearings and is fitted with either Cork sealing washers or synthetic Rubber oil seals.



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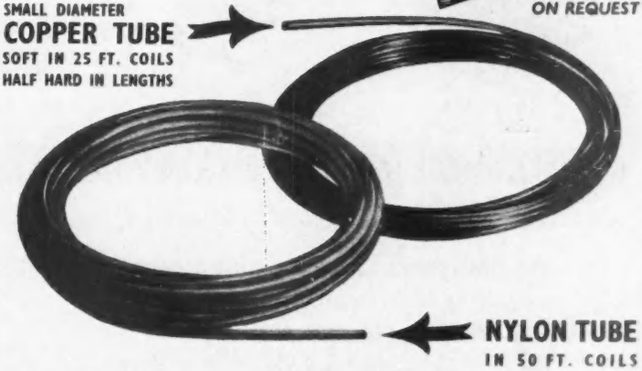

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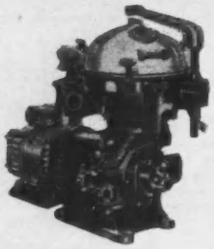

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machine tool exhibition: four special numbers of 'Engineering'

'Engineering' will publish four special numbers—June 17 and 24, and July 1 and 8.

June 17 issue : special articles will include—

Future Trends in Manufacturing Techniques, by F. Griffiths, Chief Production Development Engineer, British Motor Corporation. How Hydrostatic Drives Might Change the Shape of Conventional Machine Tools, by D. Firth, A.M.I.Mech.E., Fluid Mechanics Division, National Engineering Laboratory.

Also six pages describing and illustrating the first of four groups of new exhibits at the exhibition; and there will be extra notes and articles on current production topics.

First special number of 'Engineering'

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V—BELT DRIVES

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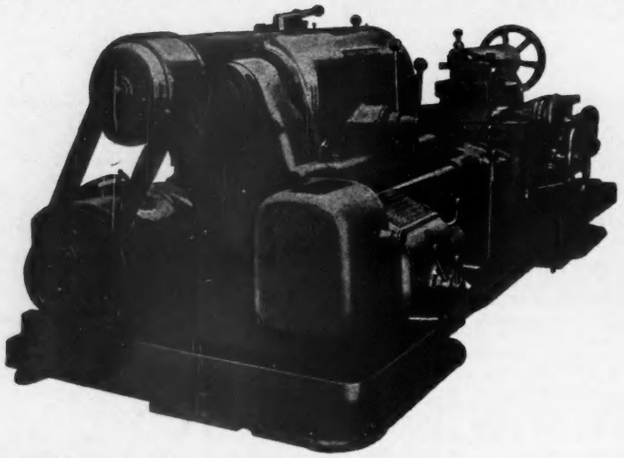

The photograph shows one of our drives mounted on a Denham Model SSB heavy duty centre lathe.

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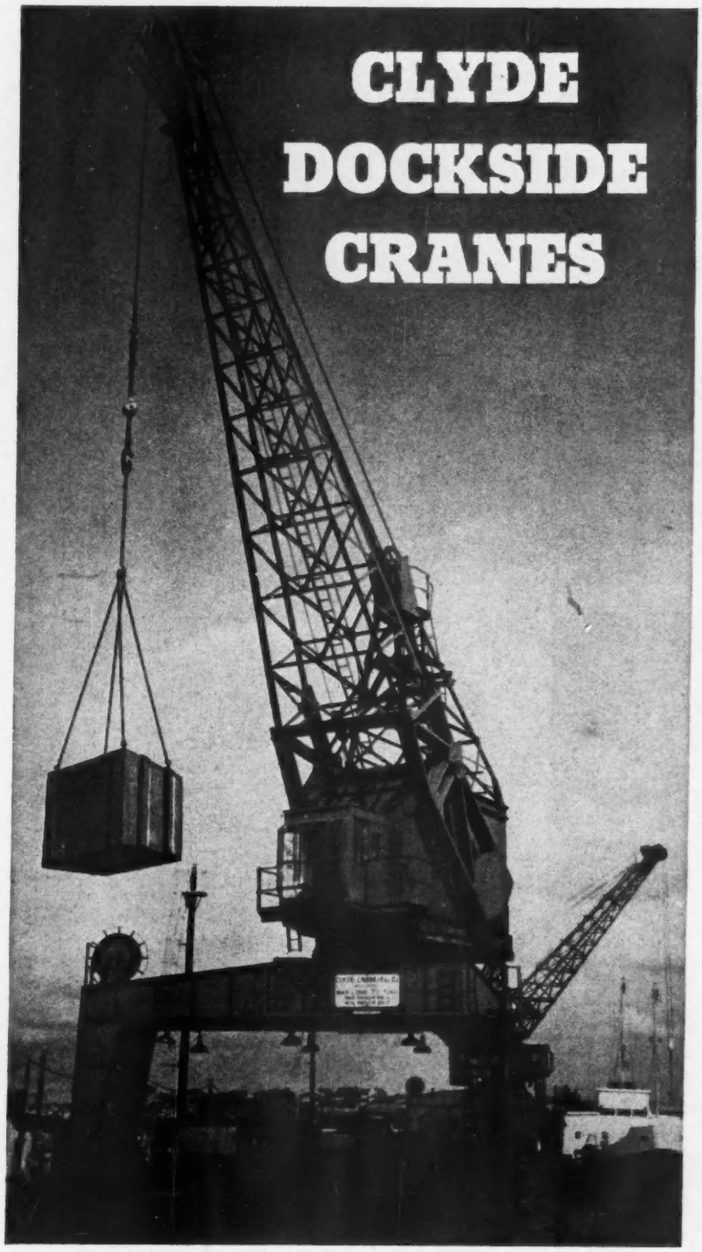

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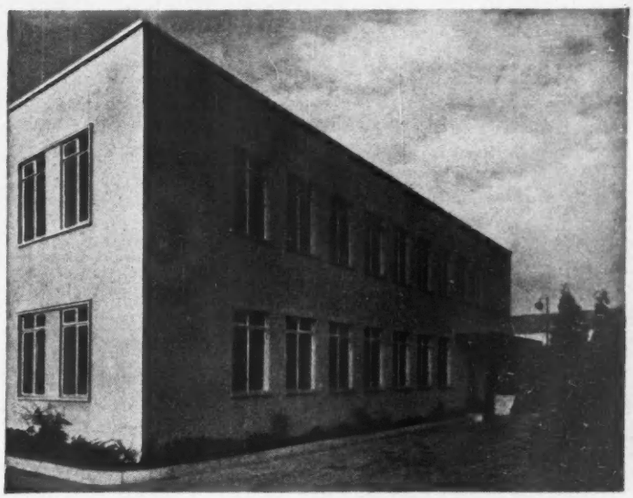

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No. 17	Dry	+ 1750°C	Hydraulic	1200°C	1700°C	160
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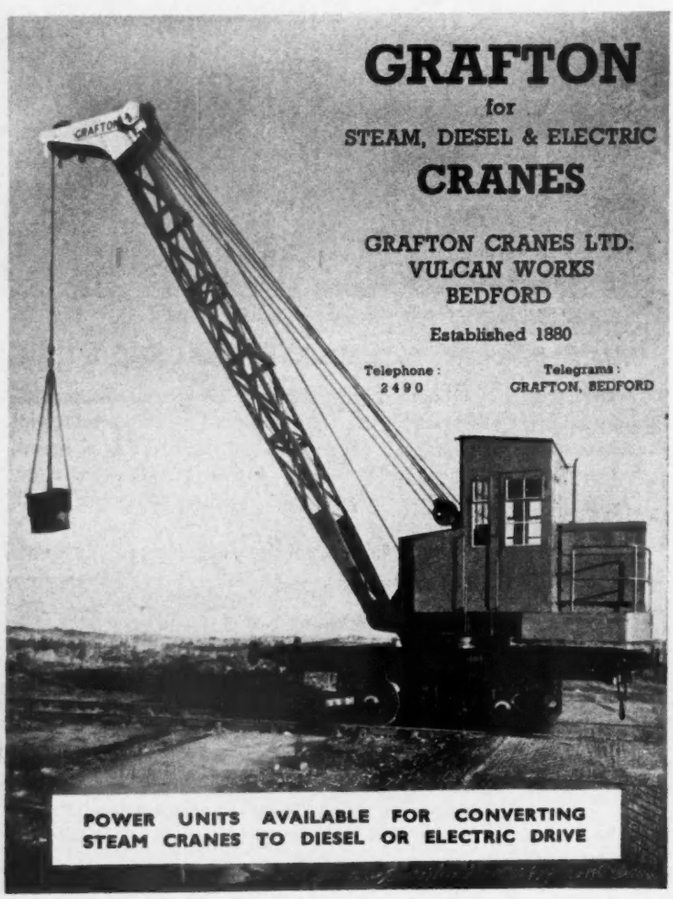

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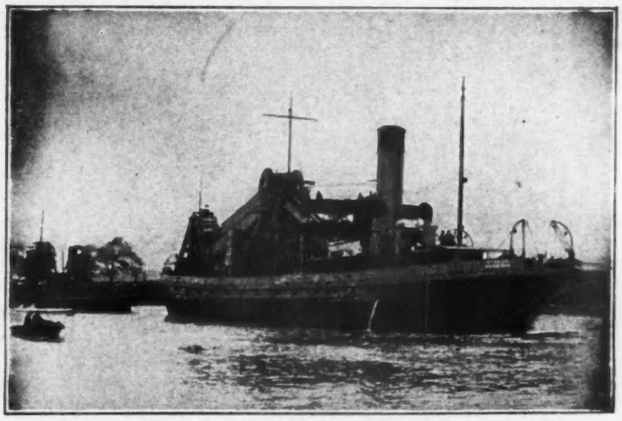

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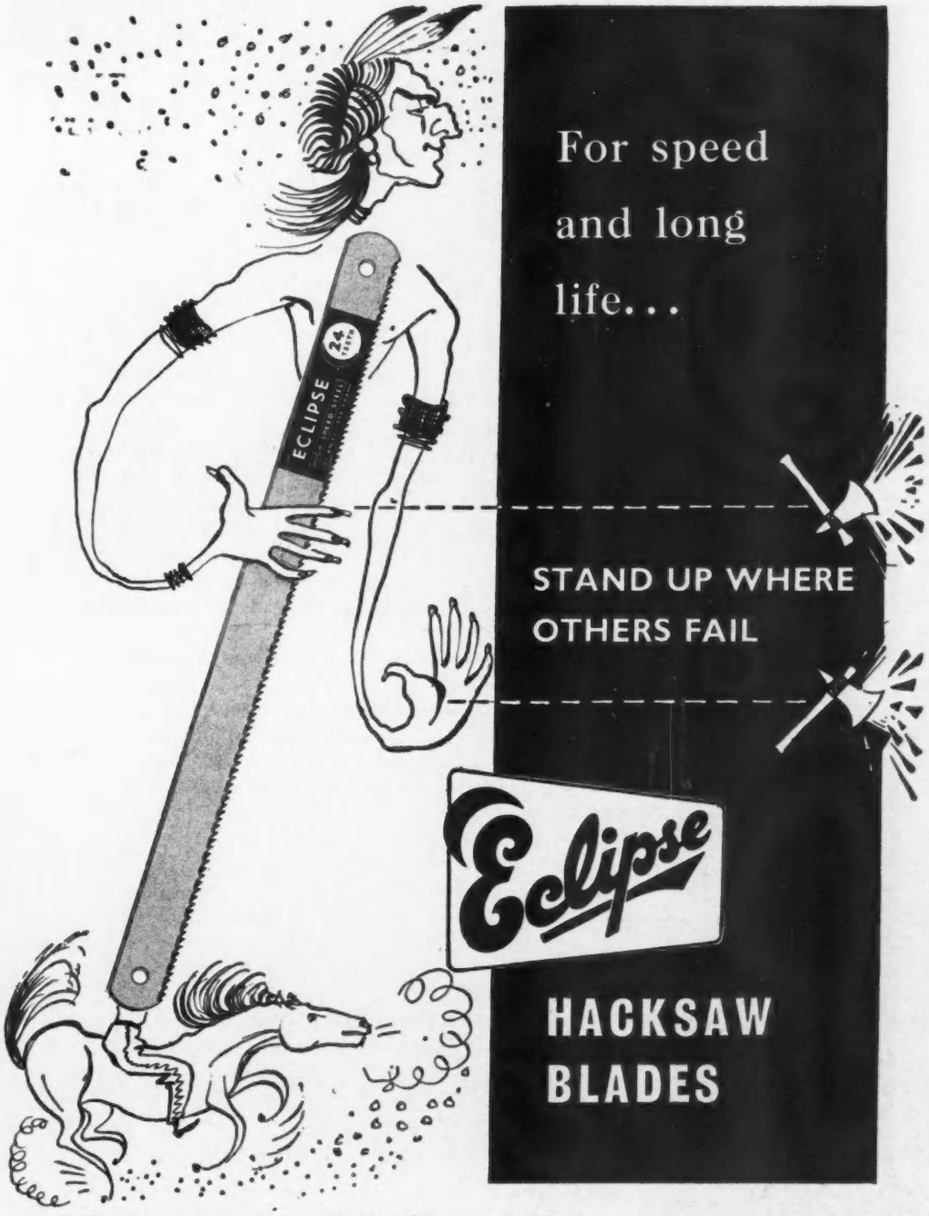

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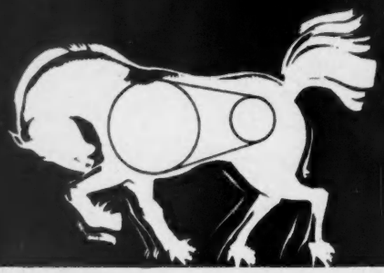

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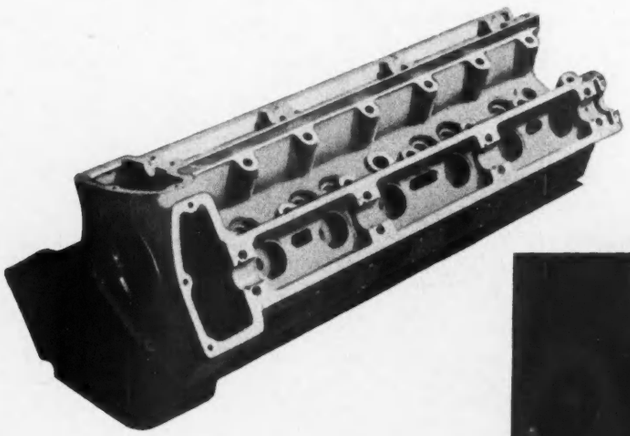
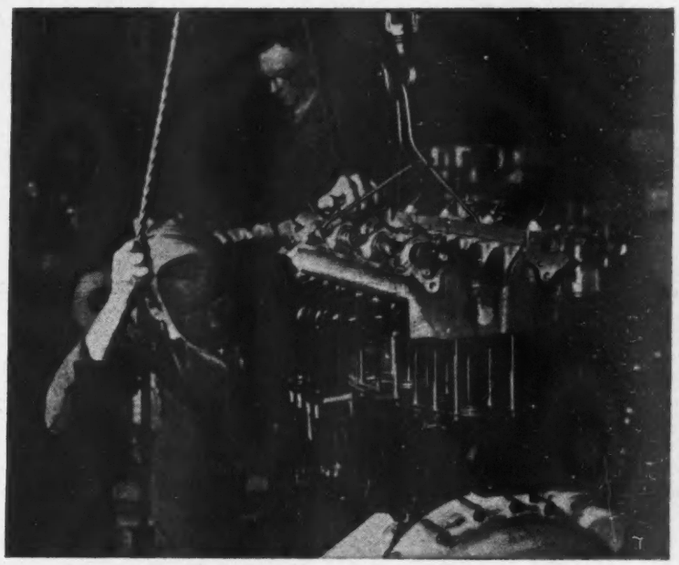
CW 6791

On with her head!

For many years, William Mills have supplied aluminium castings for the cylinder heads, sumps and manifolds of Jaguar cars. The range of Mark 2 models, introduced for 1960, uses similar castings in LM4 alloy, and the intricate cylinder head casting shown is a fine example of modern foundry technique.



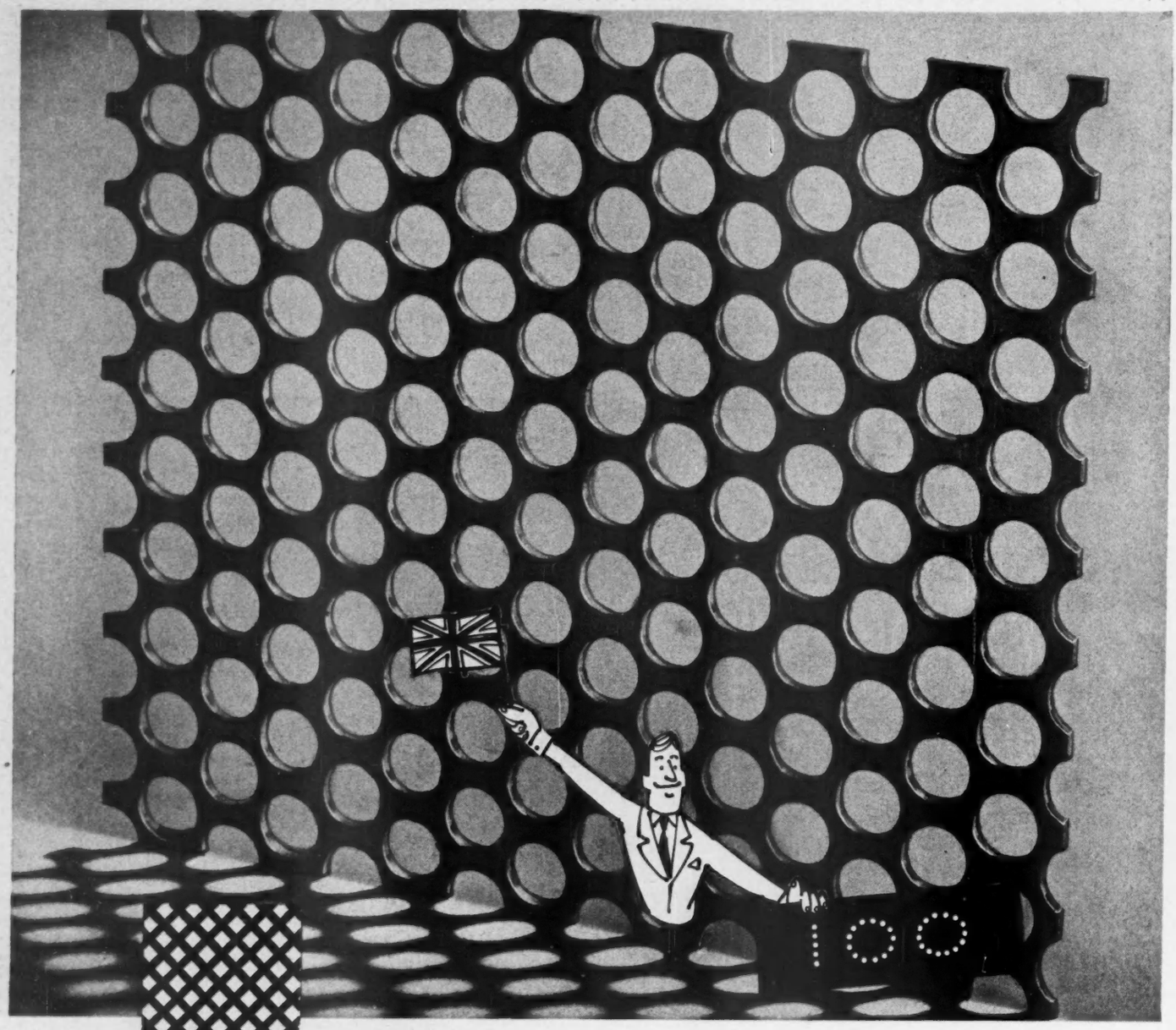


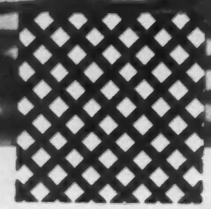
Aluminium alloy castings by

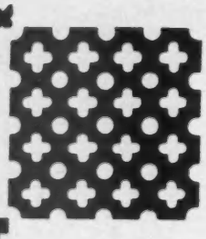
William Mills Limited

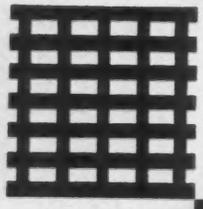
WILLIAM MILLS LIMITED, FRIAR PARK FOUNDRY, FRIAR PARK ROAD, WEDNESBURY, STAFFS

AP 132





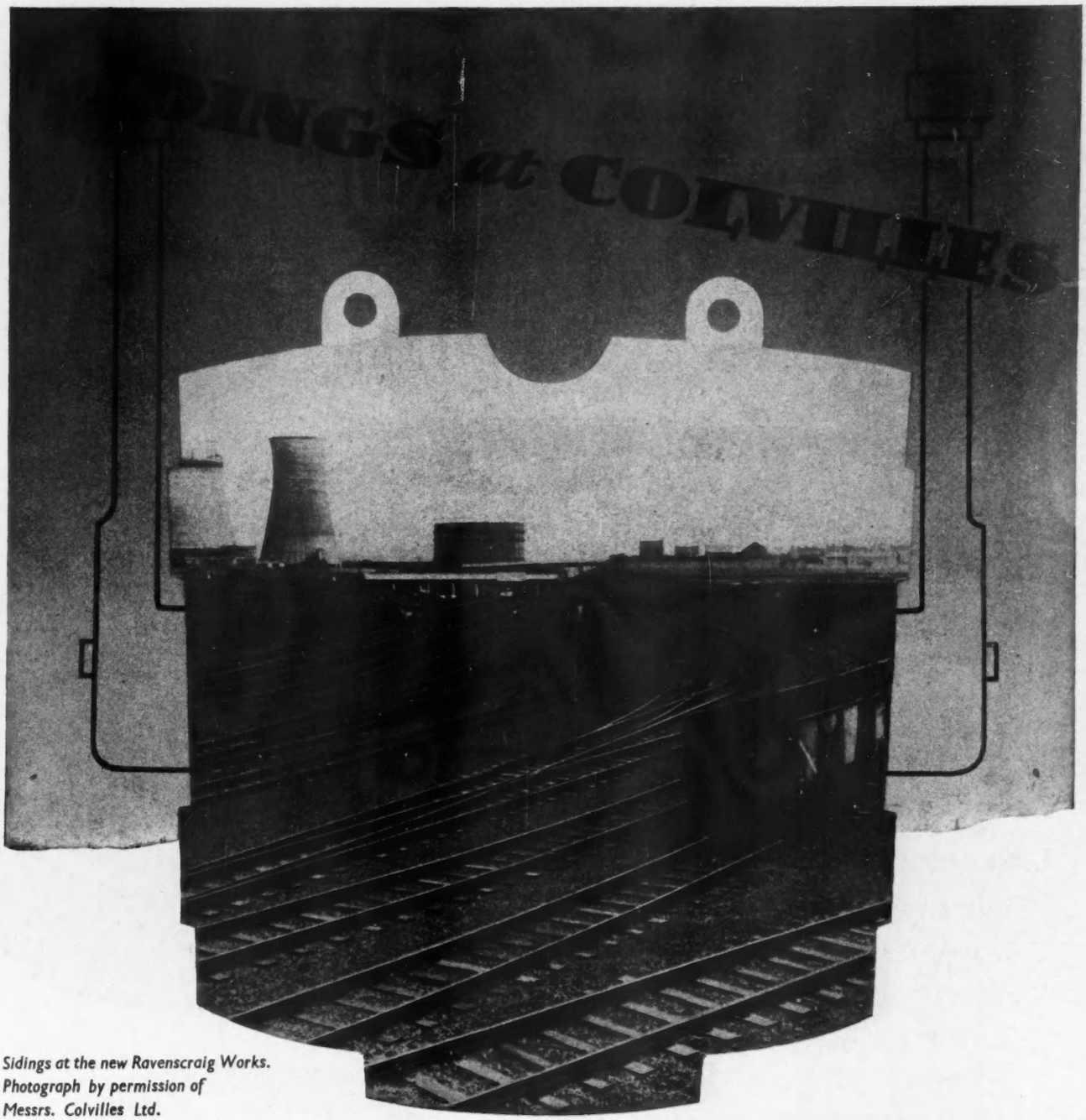




W. BARNS & SON (HOLLOWAY) LIMITED are proud to announce their hundredth anniversary. They extend thanks to their many clients for valued support in the past and, with the opening of their new extension last year, assure them of continued and even better service in the future.

WIRE WEAVING BARNS PERFORATED METALS

W. BARNS & SON (HOLLOWAY) LIMITED · Globe Works, Queensland Rd., Holloway, N.7 Tel: NORth 3347/8 Grams: Perforation, Holway, London



Sidings at the new Ravenscraig Works. Photograph by permission of Messrs. Colvilles Ltd.

By WARDS

For over 60 years Wards have been building sidings. Backed by the resources of the WARD group of companies, Rail Department's facilities enable the carrying out of contracts of all sizes simultaneously.

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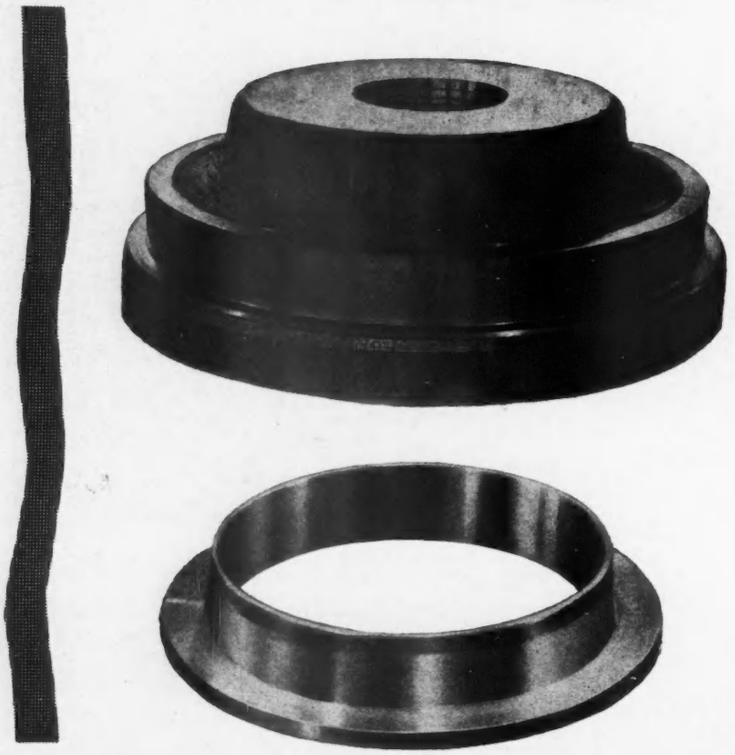
Rings and Circular Die Forgings

Seamless Rings in Carbon and Alloy Steels. Flanges of all types. Gear Rings and other rings with square, rectangular or profiled cross section, from 6 inches (min. weight 70 lb.) to 78 inches inside diameter and from 2 to 12 inches axial width. Circular Die Forgings, maximum weight 2000 lb. — Plain or punched slabs and special shaped forgings up to 40 inches diameter



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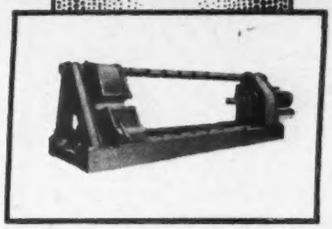
TRAFFORD PARK STEELWORKS, MANCHESTER 17

LONDON OFFICE: ST. ERMIN'S, CAXTON STREET, WESTMINSTER, S.W.1.

NEW POWER by REED

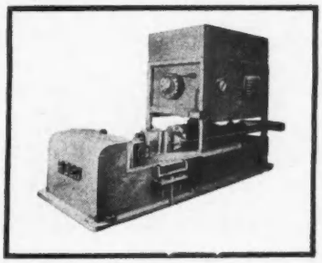
600 TON PLATE EDGE CURVING PRESS

Tables 6′ 0″ long. Can also be supplied in range of powers and table sizes. Complete with pumping equipment.



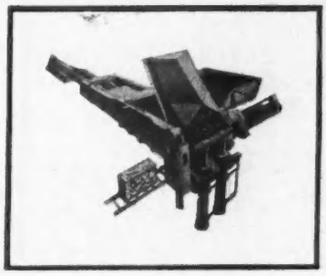
300 TON HORIZONTAL WHEEL PRESS

For wheels 4′ 4″ dia. axles 9′ 6″ long. Complete with pumping equipment.



200 TON HORIZONTAL BENDING AND STRAIGHTENING PRESS

Complete with pumping equipment.

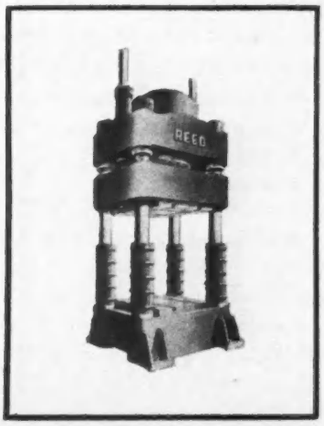


SCRAP METAL BALING PRESS (Steelworks type)

Finished bales 24″ × 30″ × 84″ long (max.). Complete with pumping equipment.

1,460 TON FLANGING AND DISHING PRESS

Adjustable daylight from 13′ 0″ to 9′ 0″. Column centres 15′ 4″ × 8′ 6″. Complete with hydraulic system.



500 TON DOWNSTROKE PRESS

60″ daylight, 24″ stroke, 40″ square. Clear space on tables. Complete with pumping equipment.

ALSO

REED LOMBARD Mechanical and Hydraulic Draw Benches. 10,000 lbs. to 350,000 lbs. range. 50 TON and 100 TON Progressive Dishing Presses. 100 TON to 4,000 TON Multi-Daylight Platen Presses with auto. load and unload equipment. 500 TON Extrusion Press. Horizontal Type, with self-contained pumping equipment. 15 TON Laboratory Metals Extrusion Press. 1,000 TON to 5,000 TON Hobbing Presses, Metal Swarf Cylindrical type Baling Press fixed or mobile type, Metal Powder Compacting Press.

Sole Manufacturers and Selling Agents in the U.K. for REED LOMBARD ◇ tube Drawbenches

Quotations supplied for "CUSTOM BUILT" Hydraulic Equipment to customers' specific requirements

REED BROTHERS

REPLANT WORKS, WOOLWICH INDUSTRIAL ESTATE, LONDON S.E.18. Phone: WOOlwich 7611/6. Cables: Replant, London.

The "Margam Abbey"—built for the Port Talbot Pilotage Authority by Richard Ironworks Ltd., in which Cor-Ten was used extensively. Photograph by courtesy of the Port Talbot Pilotage Authority

COR-TEN GOES DOWN TO THE SEA IN SHIPS

At sea as well as ashore new uses are constantly being found for SCW Cor-Ten. It was used extensively in the construction of this vessel for the Port Talbot Pilotage Authority.

The Main Deck and Bulwark Plating
Shell Plating and Anchor Recess
Floors and Engine Seating
Chain Locker
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Bulkhead Bottom Plating
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—were made entirely from Cor-Ten. A typical example of the growing use of Cor-Ten in marine construction, and in other fields where high yield strength, together with outstanding resistance to corrosion, is vital.

COR-TEN IS TOUGHER

Weight for weight, the yield strength of SCW Cor-Ten is 50% higher than ordinary mild steel.
Alternatively—
Strength for strength, a saving of 1/3 of the weight is possible.

4-6 times more resistant to atmospheric corrosion.
Highly resistant to abrasion and fatigue.

COR-TEN SAVES MONEY

Initial costs are spread over a longer service life.

Maintenance costs are reduced.

Operating costs are lowered—in transport, payloads are bigger because of reduction in tare weight.

Please write to us at the address below for further information or for technical assistance in the application of SCW Cor-Ten to your products.

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RAILWAY ROLLING STOCK. AGRICULTURAL AND EARTH-MOVING EQUIPMENT. BARGES AND SMALL CRAFT MINE CARS. POWER STATION INSTALLATIONS

THE STEEL COMPANY OF WALES LIMITED

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BABCOCK *Cranes* *at* KARIBA

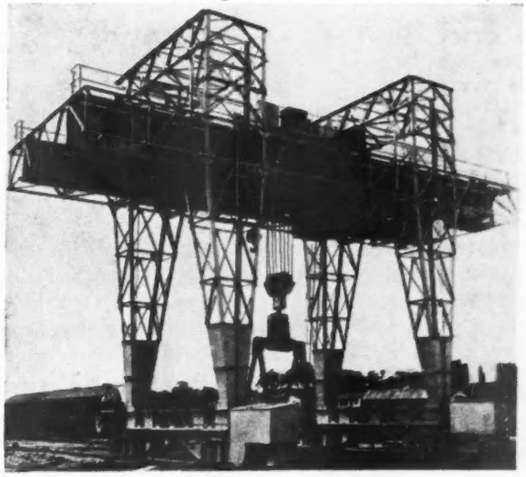
Babcock "Goliath" and overhead-travelling cranes of 100 and 200-ton capacity were chosen, against world competition, for use in the construction and servicing of the Kariba hydro-electric power station (Federal Power Board, Federation of Rhodesia and Nyasaland).

At the Lion's Den railhead serving the power station site, a 100-ton "Goliath" has greatly facilitated the storage and transit of constructional materials and heavy machinery; while in the turbine-house, the two 200-ton, overhead-travelling cranes have impressively demonstrated their precise handling of very heavy loads, during the installation of the turbo-alternators.

AHEAD OF PROGRAMME The Annual Report of the Federal Power Board (for year ended June 1958) commented that the "Goliath" at the Lion's Den railhead was then erected and in service, while the two 200-ton cranes had "already been installed and tested *ahead of programme.*"

200-TON (Above) A delicate operation calling for power with accuracy; the two Babcock 200-ton, 63-ft. span turbine-house cranes, operating together, lift a 308-ton generator rotor into place at Kariba power station.

100-TON (Below) The 100-ton Babcock "Goliath" crane, with 34-ft. rail centres and cantilever structure for side loading; at the Lion's Den railhead depot.



BABCOCK & WILCOX LIMITED, BABCOCK HOUSE, 209 EUSTON ROAD, LONDON, N.W.1

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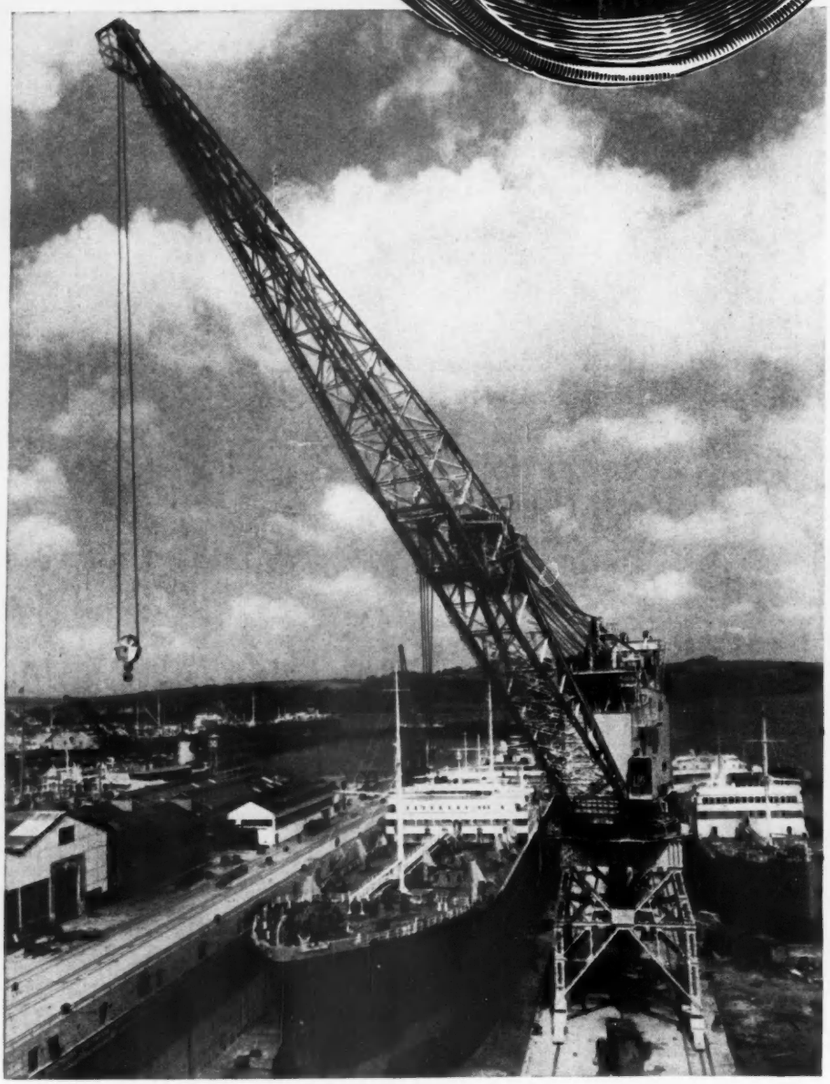

Focus on Falmouth

A new Falmouth landmark visible from far at sea is this 247 ft. high Stothert & Pitt crane built for Messrs. Silley, Cox & Co. Ltd. It is one of the largest balanced rope level-luffing cranes in the country and can lift up to 61 tons at 105 feet radius. Ward Leonard hoist drive ensures precise control on both main and auxiliary hooks.

The 175 ft. maximum working radius enables 12-ton loads to be picked up from the far side of the new Queen Elizabeth Dry Dock which accommodates vessels up to 85,000 tons.

For a hundred years the name "Stothert & Pitt" has been linked with all that is best in crane design—a reputation to which this crane at one of Britain's most modern dry docks adds fresh lustre.

S&P LIMITED

STOTHERT & PITT LIMITED

ENGINEERS · BATH · ENGLAND

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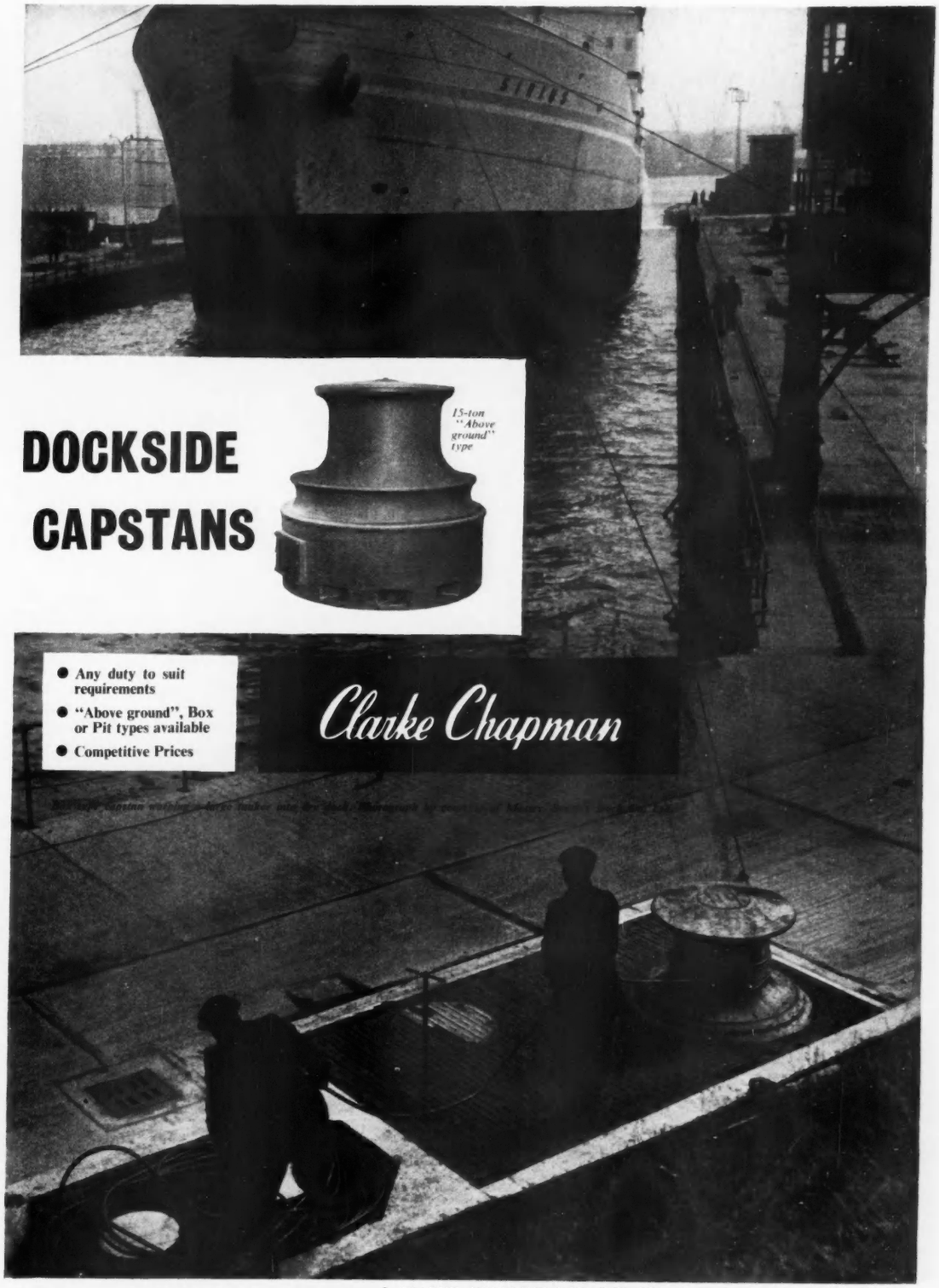

DOCKSIDE CAPSTANS

15-ton "Above ground" type

- Any duty to suit requirements
- "Above ground", Box or Pit types available
- Competitive Prices

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LONDON OFFICE: Dunster House, Mark Lane, E.C.3. GLASGOW OFFICE: 116 Hope St. C.2.
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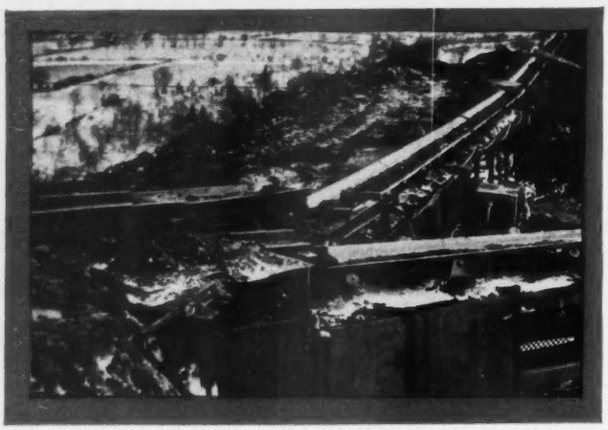
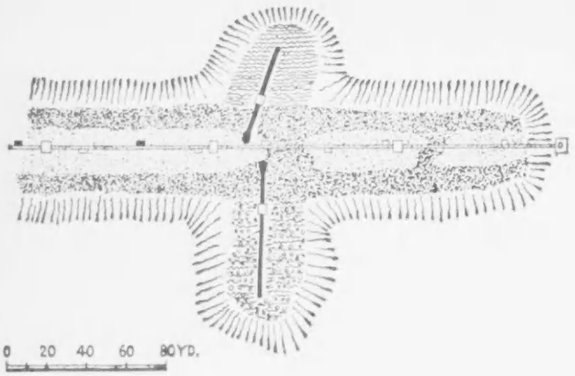




DISTINGTON-GOODMAN

DUCKBILL LOADER & SHAKER CONVEYOR spread 7,250 tons of colliery waste per week

—more than 1,000,000 tons without repair or overhaul

Waste heaps which have reached their maximum height can be extended laterally in any required direction without shifting aerial ropeways. Duckbills and shaker conveyors have been doing this 'earth-moving' job reliably for many years. Automatic loading below the aerial discharge point, easy extendability, and adaptability to changing terrain have been important advantages of this equipment, which can easily keep pace with normal dumping rates and if need be, work 'round the clock.' This machinery has handled waste with maximum water absorption.

The photographs show a shaker conveyor working in conjunction with two belt conveyors. The diagram shows a scheme in its early stages employing a duckbill and a shaker conveyor alone. With this scheme, the life of the tipping area has been extended by 20 *years without movement of or addition to the ropeway.*

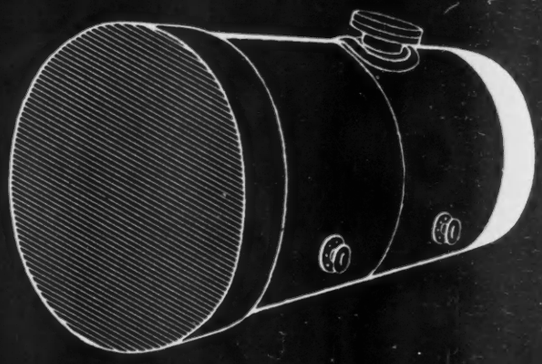
DISTINGTON

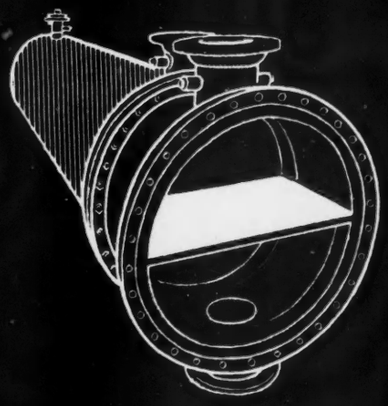
DISTINGTON ENGINEERING COMPANY LIMITED
WORKINGTON · CUMBERLAND · ENGLAND

DB 21

STEELS UNIQUE 3 WAY SERVICE

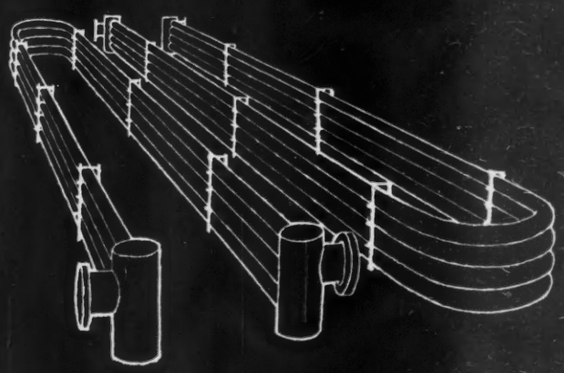
PRESSURE VESSELS





HEAT EXCHANGERS

FABRICATED PIPEWORK



Our new factory is equipped with the latest scientific aids to fast, economical production. We can roll 2" mild steel plate, 5' 6" long, down to 30"—with proportionate manipulation in other materials—and stress-relieve vessels up to 45' in length. Quality control includes a 300 kV mobile x-ray unit and well staffed chemical and physical laboratories which enable us to manufacture to all British and Foreign Codes of Practice.

WHY NOT FIND OUT MORE ABOUT THIS 'UNIQUE THREE-WAY SERVICE'

Steels bring new scientific skill to industrial problems.

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STEELS ENGINEERING INSTALLATIONS LIMITED

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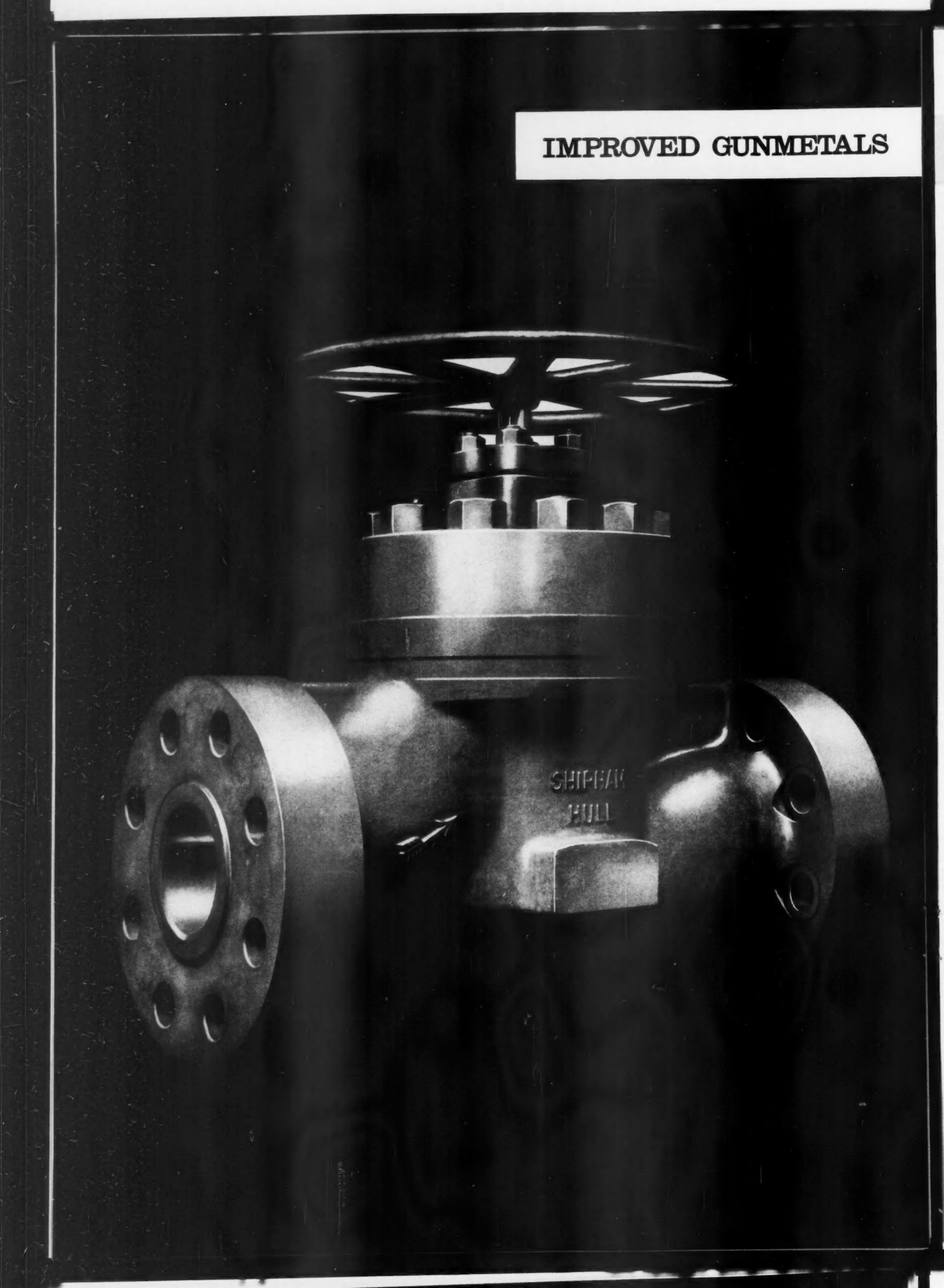
IMPROVED GUNMETALS



FOR QUALITY CASTINGS

This one ton valve withstands test pressure of 5,200 p.s.i. air

This valve for handling liquid oxygen shows the superiority of Improved Gunmetals over conventional materials. The valve weighs 2,408 lb. with sections varying from 2¼ to 5 in. in thickness. Admiralty gunmetal was originally specified in view of the very heavy sections involved, but all castings leaked at well below the pressures required. Improved Gunmetal containing Nickel, however, successfully withstood pressures of up to *5,200 p.s.i. air* without leakage.

SEND FOR THIS BOOKLET *which describes the properties of Improved Gunmetals and shows how you can benefit.*

IMPROVED GUNMETALS PROVIDE:

Uniformly high mechanical properties and pressure tightness in castings of variable section.

Good castability · Ease of production

Please send me a copy of your booklet on 'Improved Gunmetals for Quality Castings'

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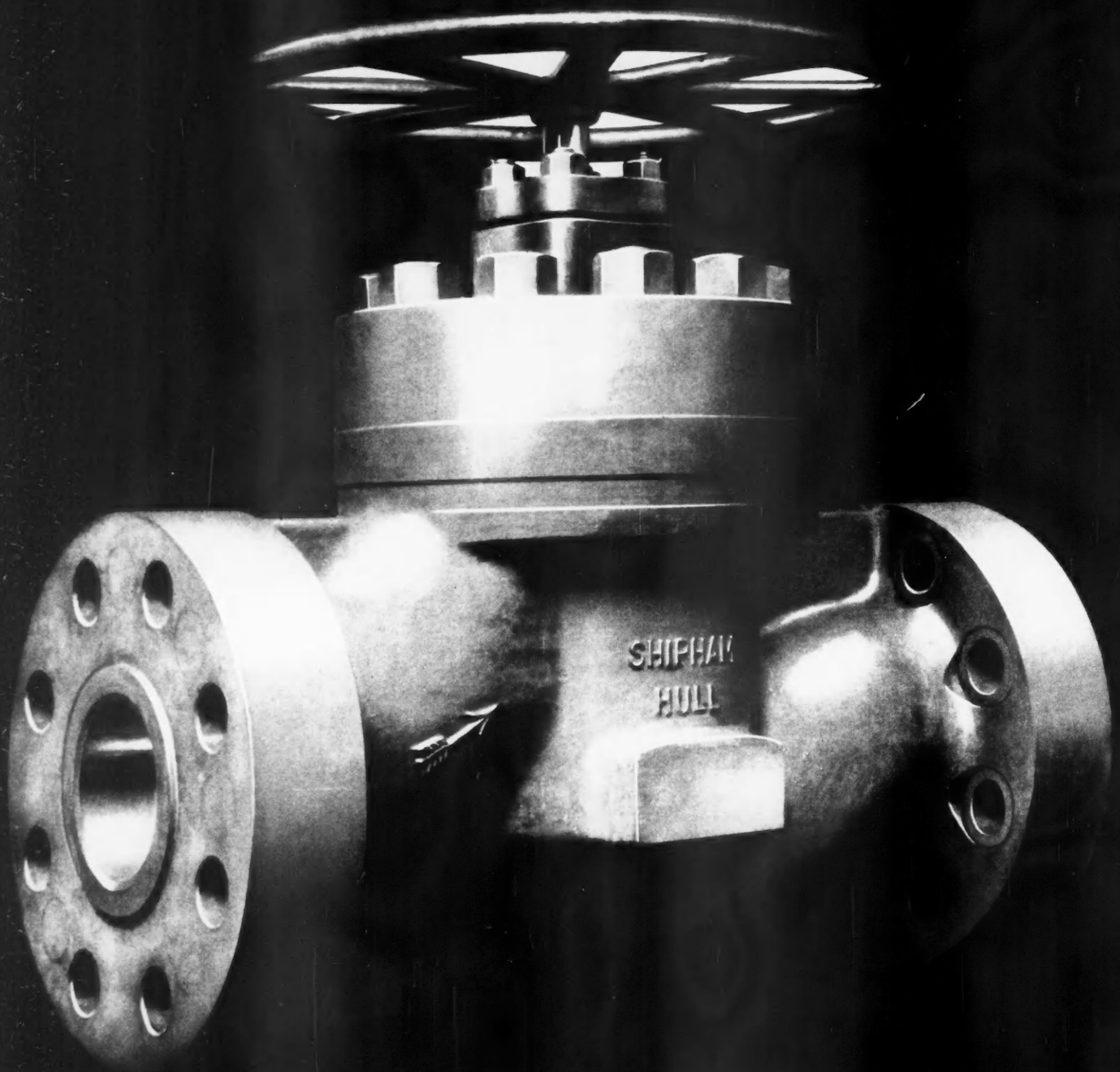
EE GN38/5

THE MOND NICKEL COMPANY LIMITED, THAMES HOUSE, MILLBANK, LONDON, S.W.1

TGA GN38A

IMPROVED GUNMETALS



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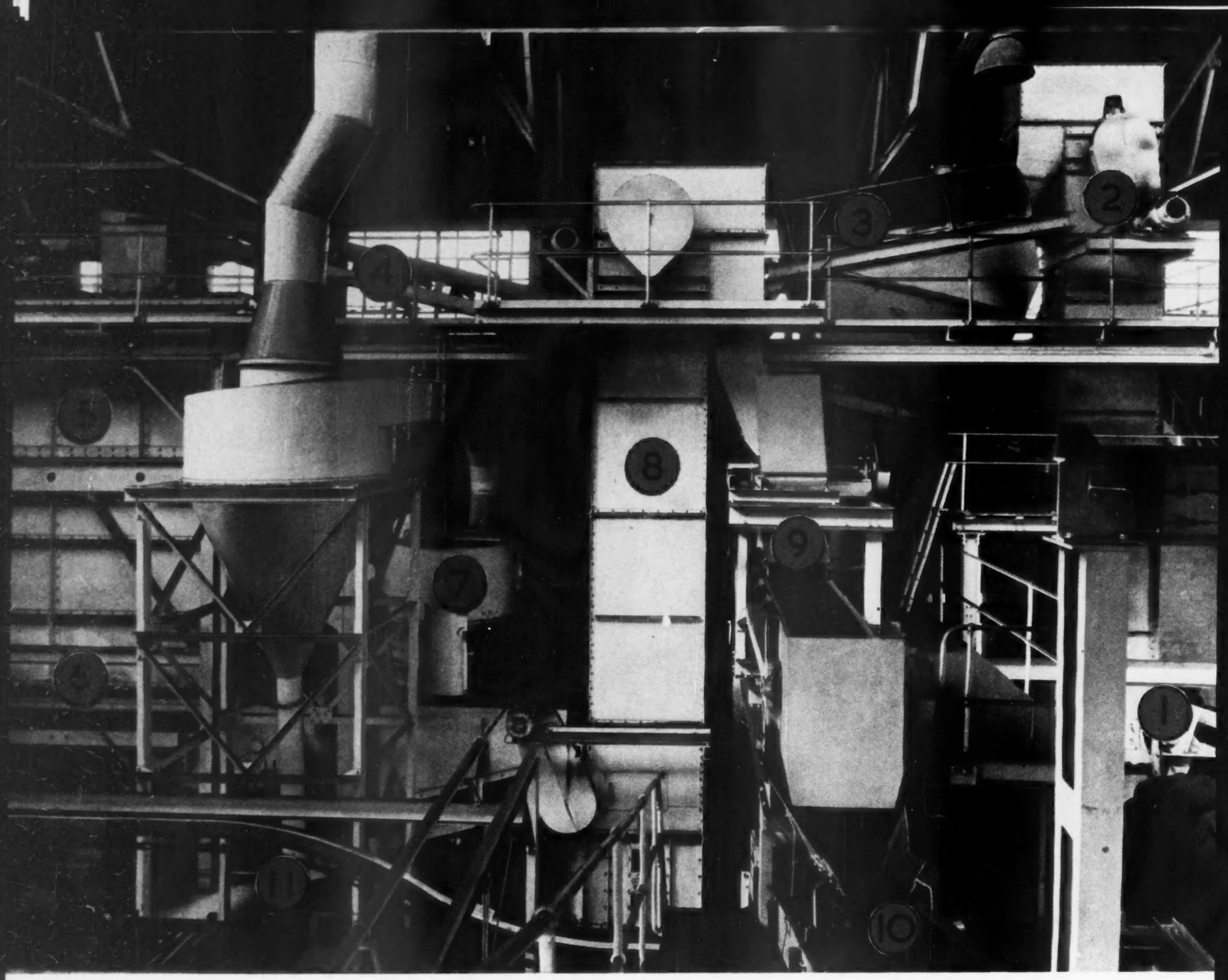

The illustration shows that part of a **MORRIS** foundry sand and mechanization plant which re-conditions knocked-out sand. At **1**, sand coming from the knock-out via an apron plate and belt conveyor passes beneath a magnetic separator (to remove tramp iron) and falls into the boot of a belt-bucket elevator, **2**, discharging into screen **3** onto belt conveyor **4** which in turn discharges into sixty-ton storage hopper **5**. The flat belt conveyor, **6**, under the hopper, pours sand into the skip which feeds the mulling machine (known as the Speedmullor). This machine **7**, providing a rapid mulling cycle with close batch control, discharges the sand into belt-bucket elevator **8**. From thence, the sand proceeds via belt conveyors **9** and **10** to the moulders. The overhead chain conveyor **11** serves the core shop with sand and also takes the cores to the stoves and to the moulders.

Consult MORRIS

FOR COMPLETE HANDLING SCHEMES FOR ALL INDUSTRIES

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TELEPHONE LOUGHBOROUGH 3123

Problem: **HEAT**

Solution: **COLT Ventilation**

Place: LEYLAND MOTORS LIMITED
LEYLAND LANCASHIRE

The Architects, Messrs. Harry S. Fairhurst & Son F/A.R.I.B.A. who designed this factory for Leyland Motors Ltd. installed Colt Ventilators throughout for three reasons:

1. They had confidence in Colt Ventilation from past experience.
2. They liked the low silhouette which would not impair the appearance of the building.
3. The installation weighed 72 tons *less* than any other ventilation equipment available, thereby showing considerable saving in structural costs.

In providing a permanent solution to this ventilation problem Colt have added yet another chapter to their record of success—success which has brought repeat orders from many world-famous concerns. Send for a free Data Manual to Dept. 36

COLT VENTILATION LIMITED SURBITON SURREY TELEPHONE: ELMBRIDGE 0161

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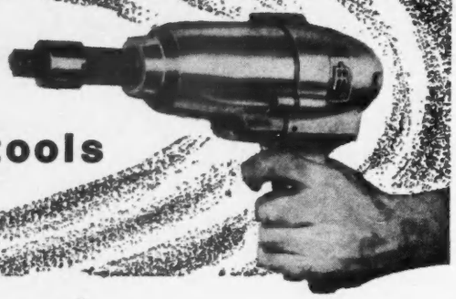
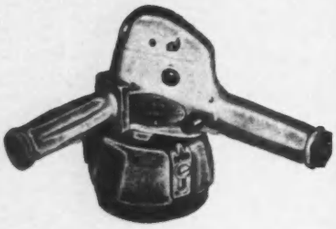
Ingersoll-Rand

air powered hand tools for industry



BRITISH MADE

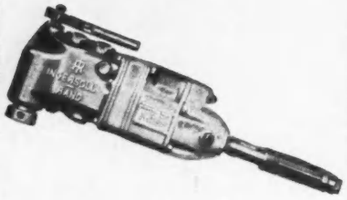


SURFACE GRINDERS

CHIPPING HAMMERS

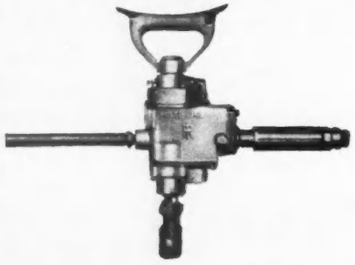
IMPACTOOLS

WELD FLUX SCALERS



CLOSE QUARTER DRILLS

MULTI-VANE DRILLS

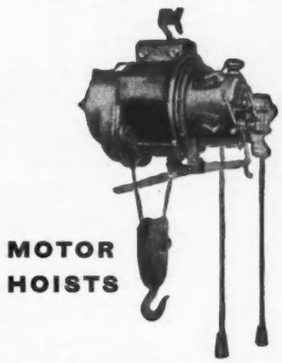


IMPACTOOLS

SCALING HAMMERS

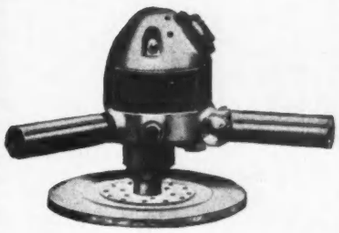
SMALL MULTI-VANE DRILLS

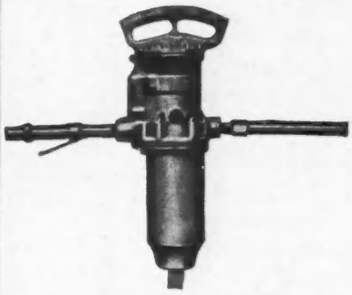
P.3781



MOTOR HOISTS

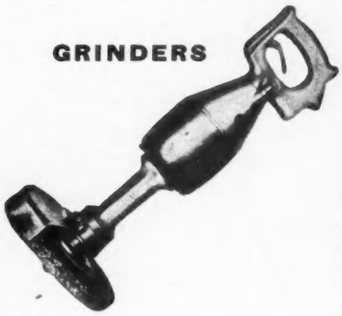
SANDERS





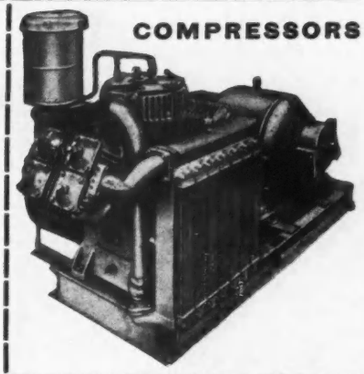
IMPACTOOLS

GRINDERS



MULTI-VANE DRILLS

COMPRESSORS



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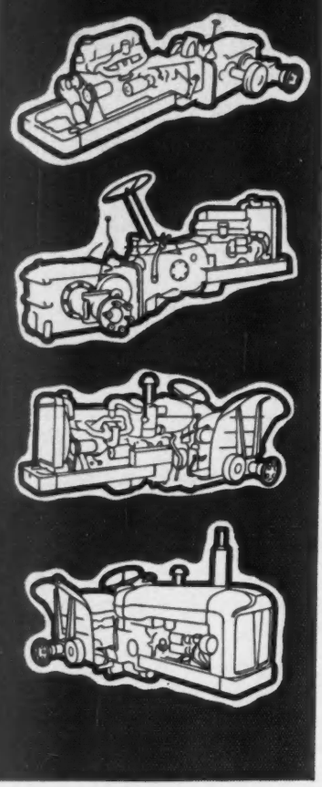

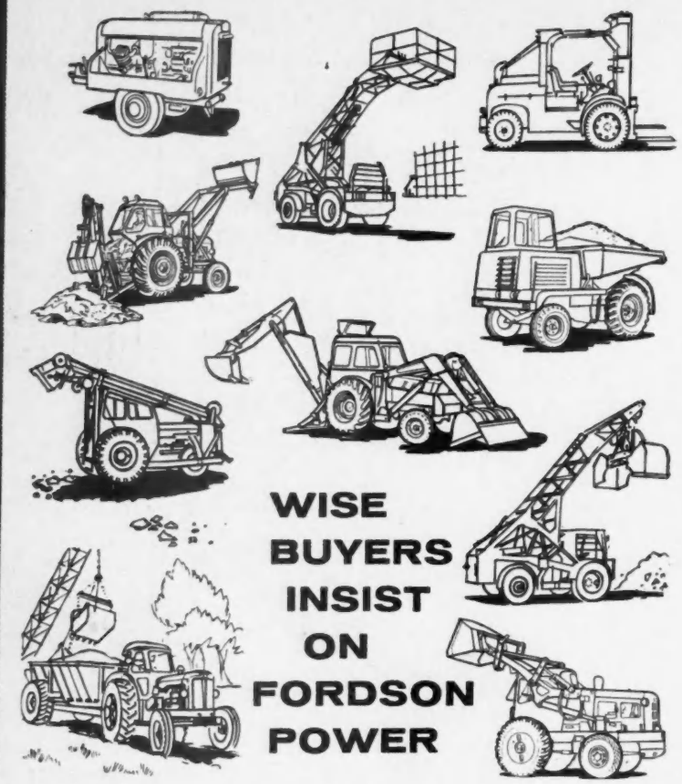

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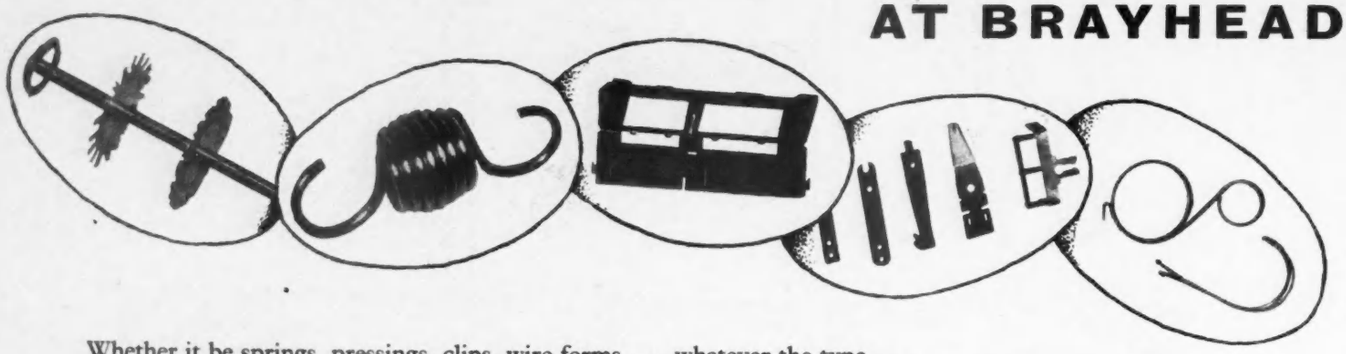

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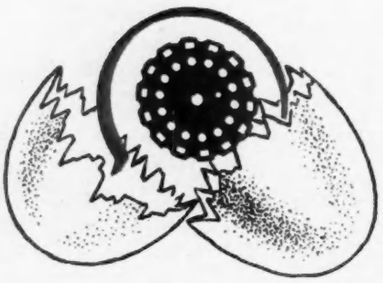

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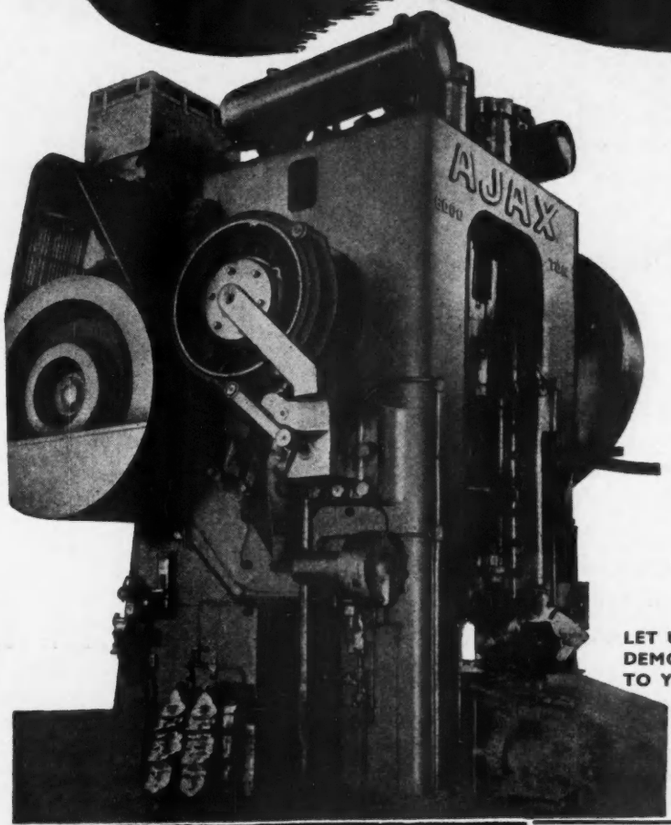

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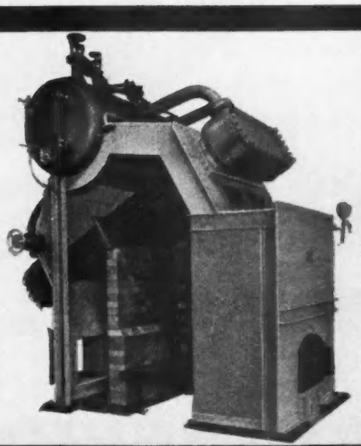

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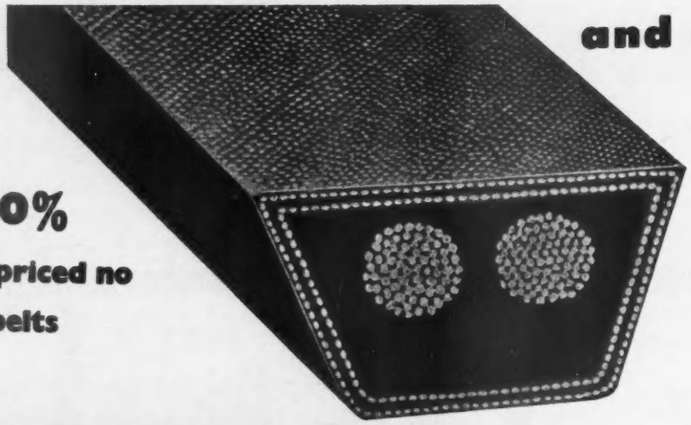
between this  and any other V-belt

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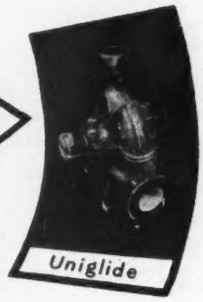

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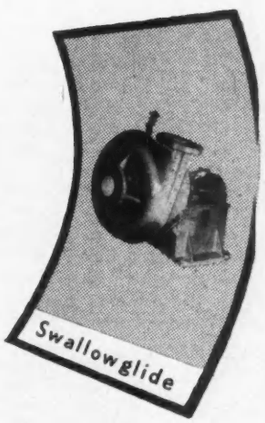

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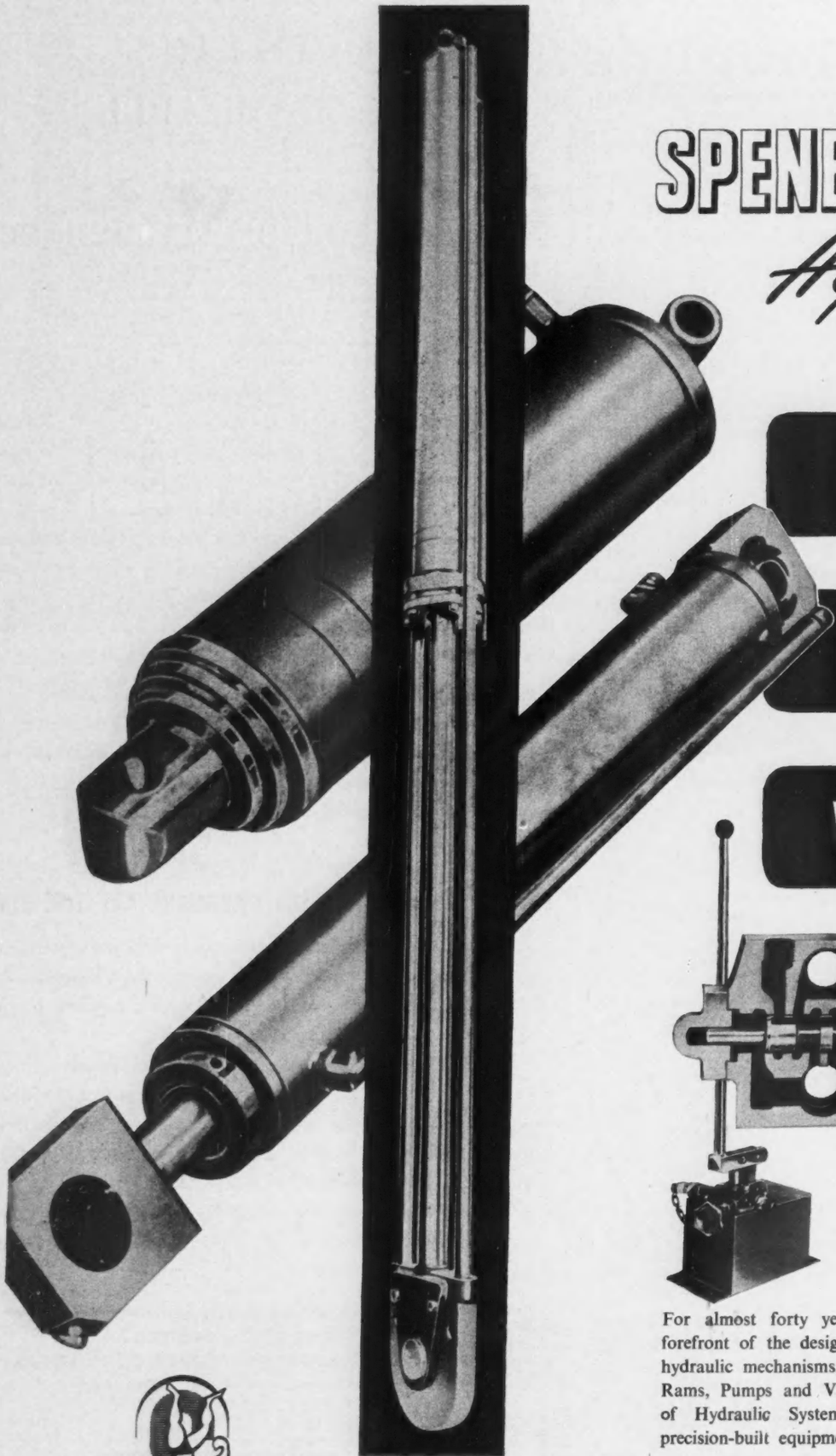

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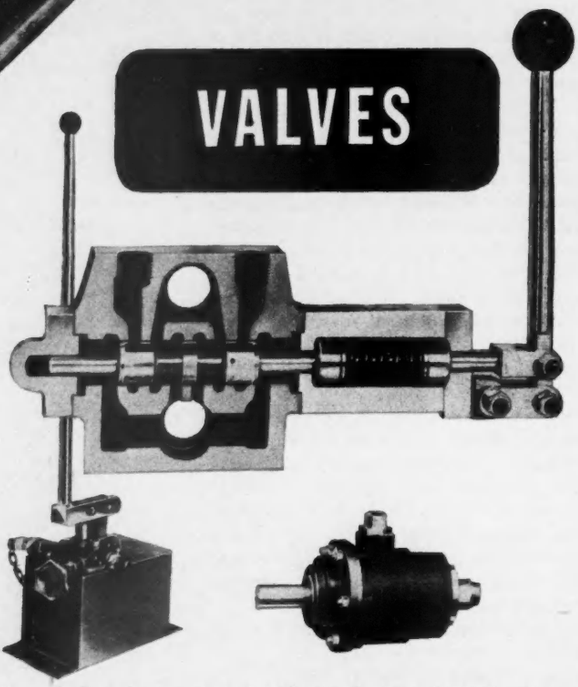

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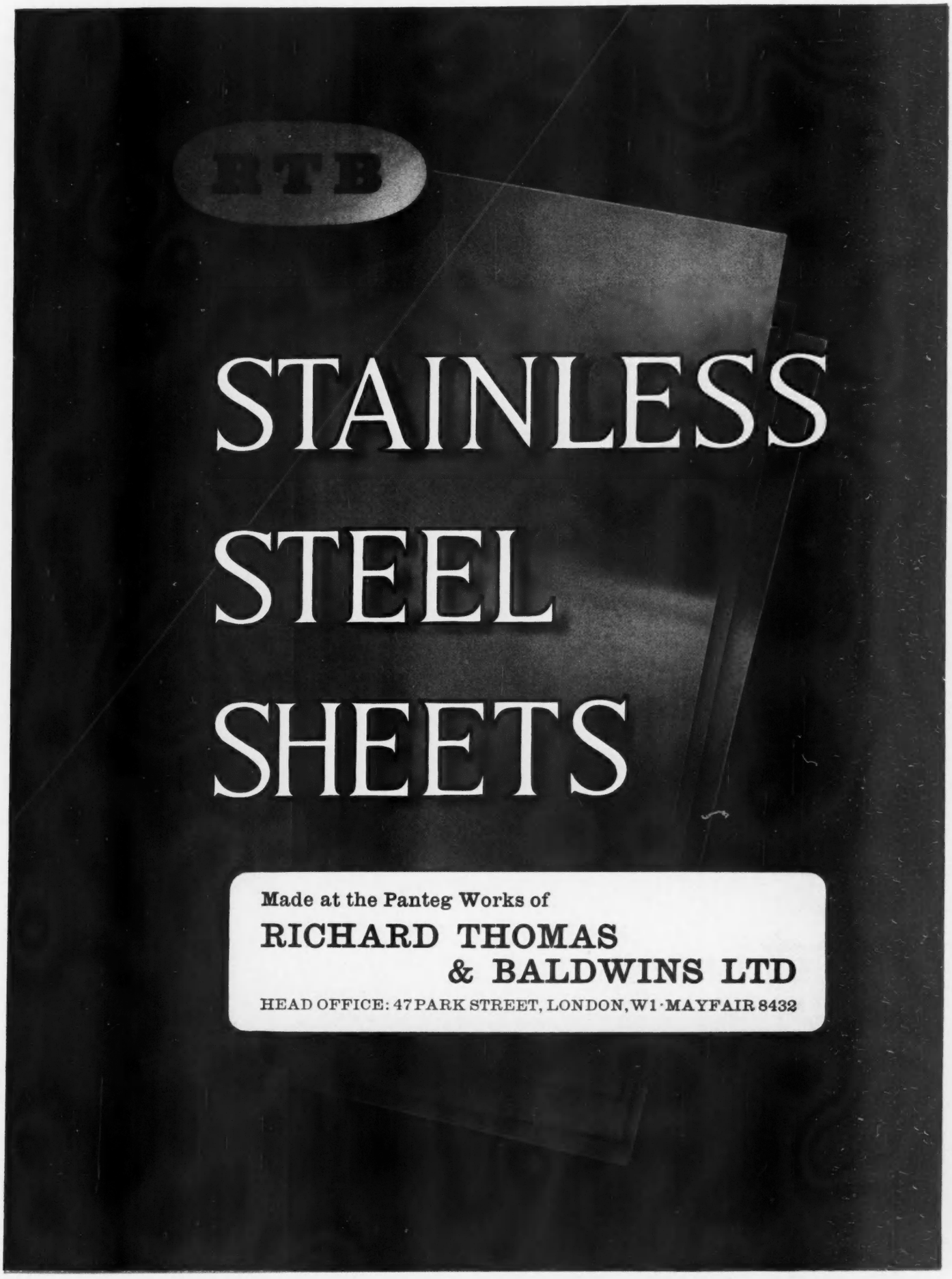
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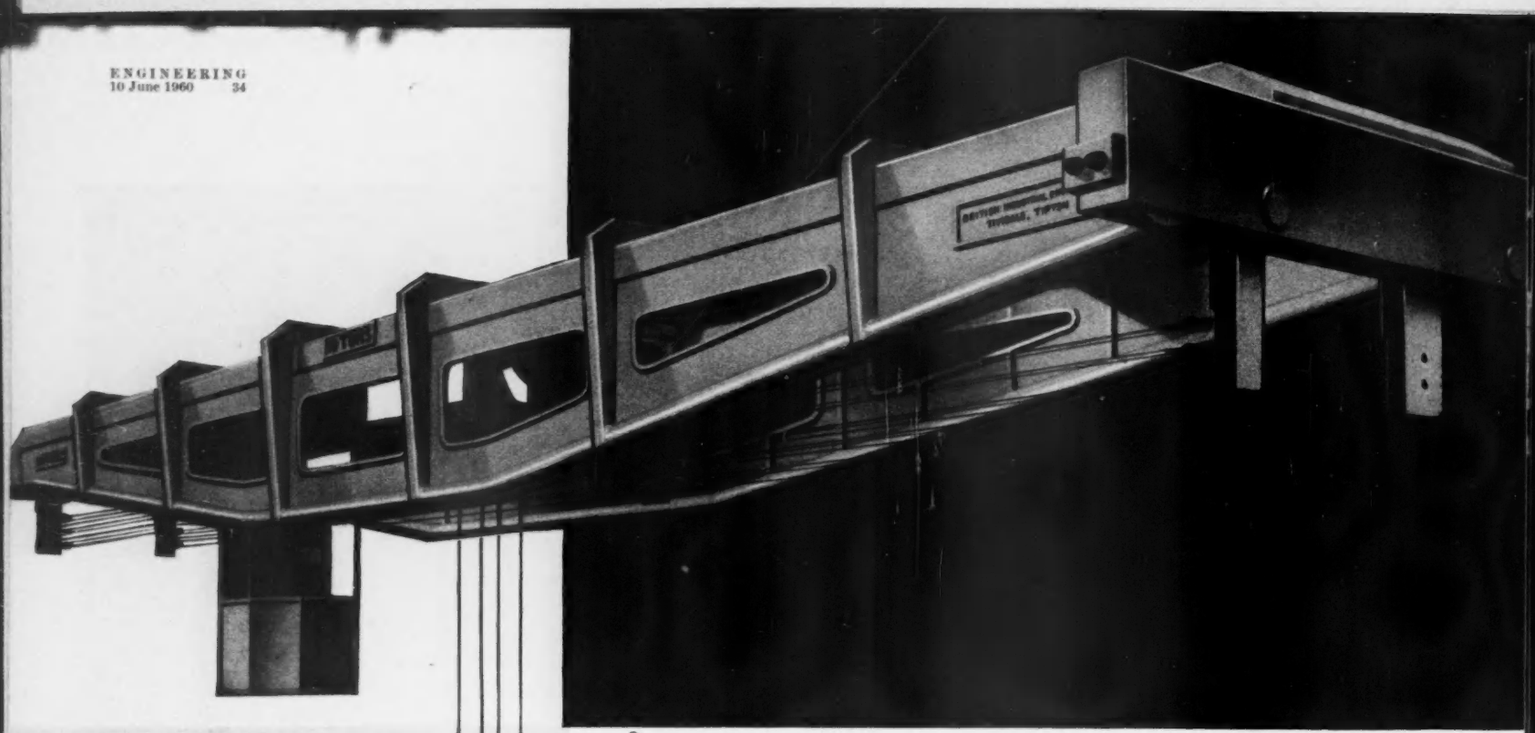

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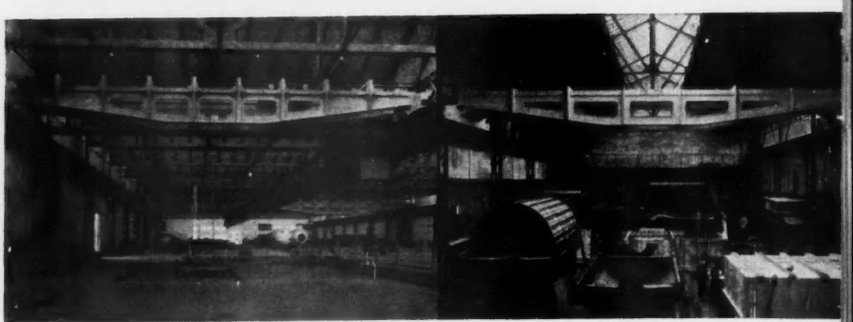

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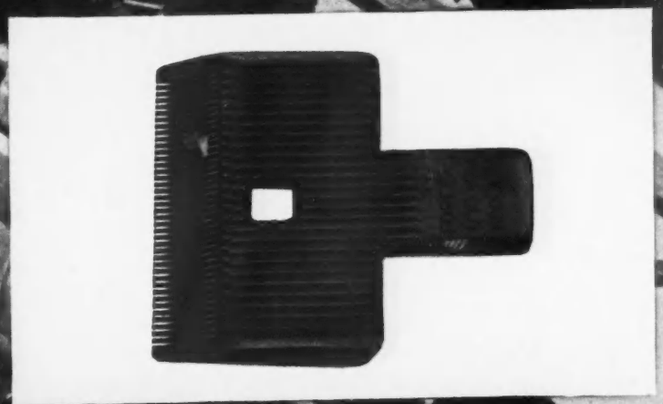

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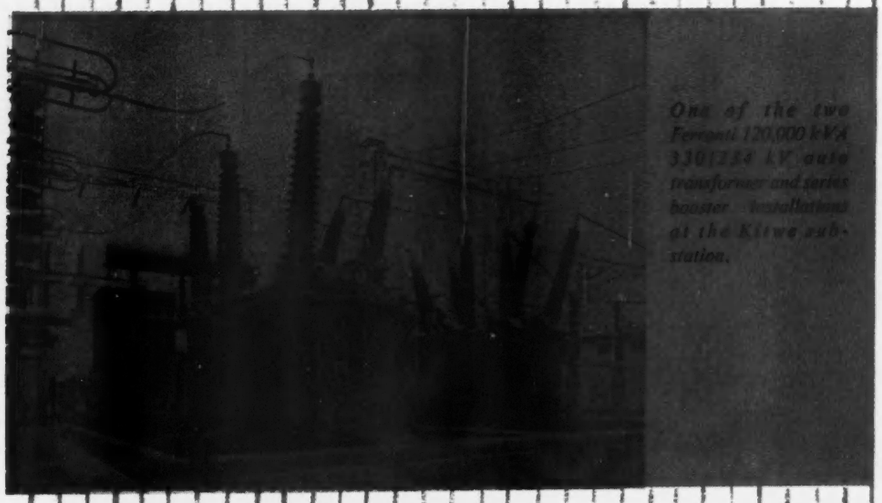
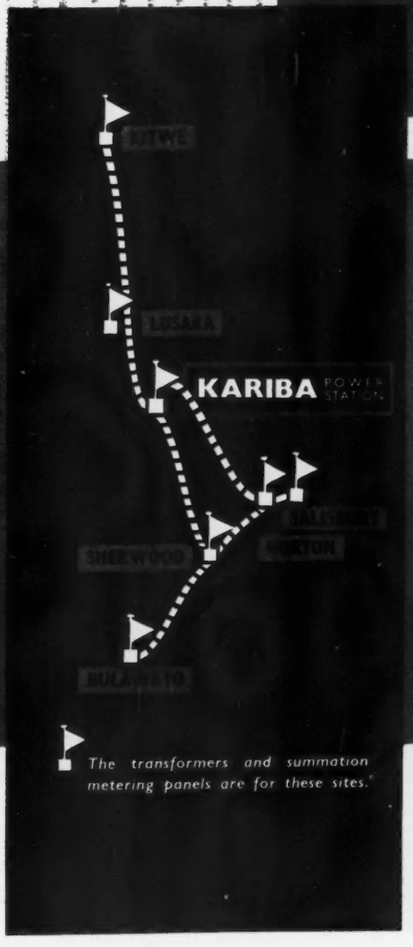


One of the two Ferranti 120,000 kVA 330/234 kV auto transformer and series booster installations at the Kitwe sub-station.

FERRANTI at KARIBA

Ferranti Summation Metering Panels for the Kariba Power Station.



The transformers and summation metering panels are for these sites.

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All the sub-station transformers for the Kariba Hydro-Electric Scheme are being supplied by Ferranti Ltd. They comprise two 120,000 kVA, 330/234 kV 3-phase auto transformers with series boosters, eight 60,000 kVA, 330/88kV and four 60,000 kVA, 330/33 kV 3-phase double wound transformers. The transformer installations at Norton, Lusaka and Kitwe are complete. Work at Salisbury, Bulawayo and Sherwood is well advanced.

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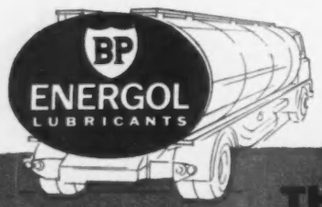

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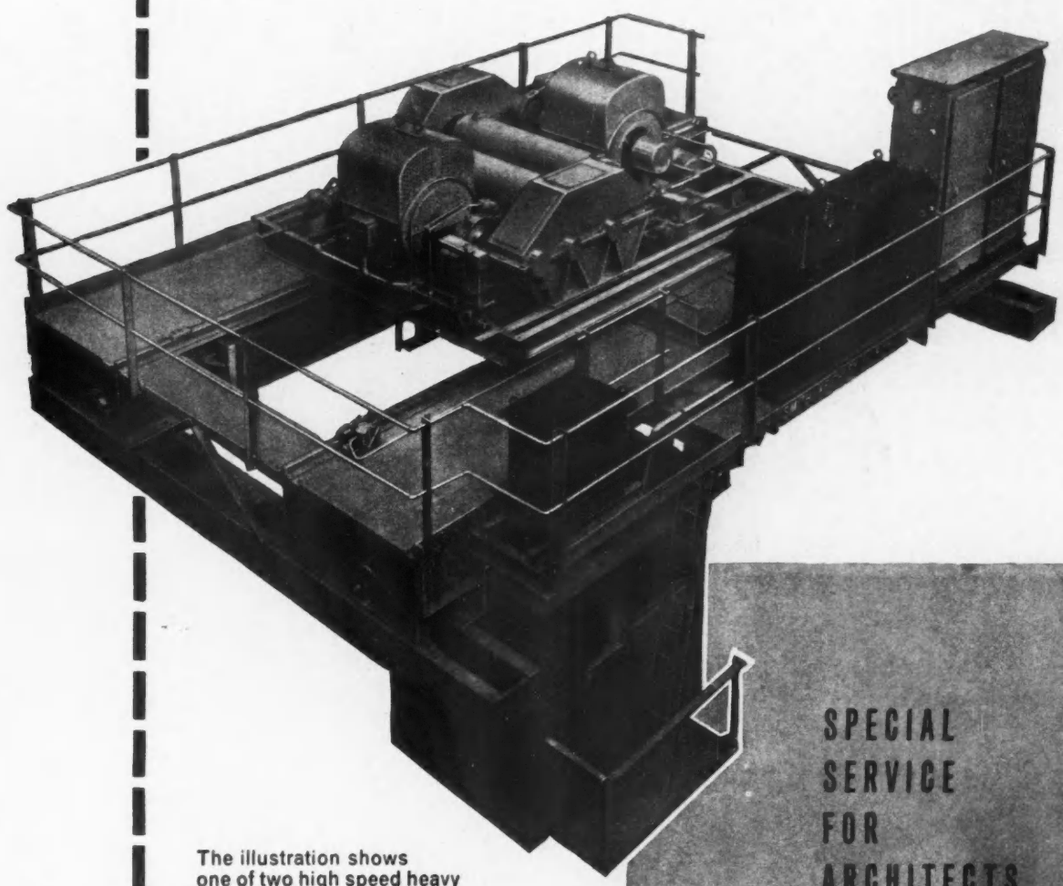
1 OUTDOOR GRABBING CRANE



The illustration shows one of two high speed heavy duty cranes for bulk handling of boiler ash at a power station. The cranes are fitted with 'Whole Tine' Grabs of the four-rope operated type, enabling the operator to discharge the load at any height. Separate motors on the crab drive twin hoisting units to operate the grabbing motion. Special attention is given to the design of the gearing and electrical control equipment, to ensure elimination of "spillage" of the load when hoisting the grab. The cranes are operating in the open and special attention has been given to the weatherproofing.

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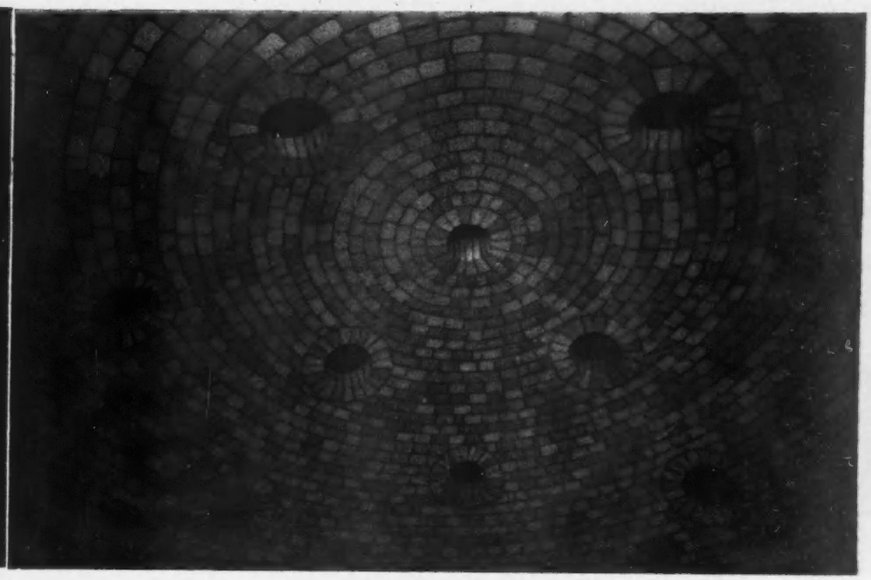
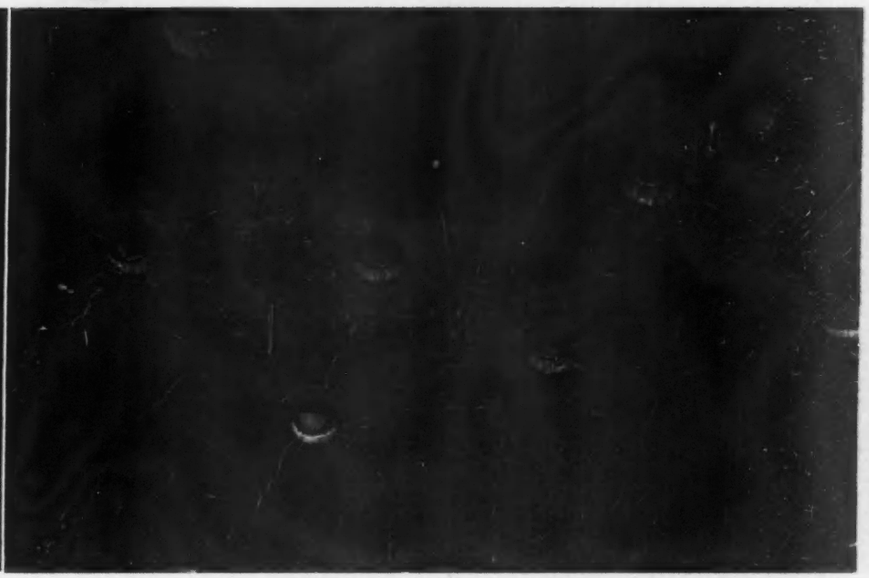


Five years ago we began rebuilding the round down-draught kilns of the Morgan Crucible Co. Ltd. at Battersea in MI.28–a hot-face insulating brick of low thermal capacity that was then comparatively new. The roof of one of these furnaces immediately after installation is shown in the first picture.

. . .(MI. 28 bricks)

. . . and like it



The output of these kilns, lined with MI. 28, was considerably greater than their firebrick counterparts, because the low heat-storage of the lining shortened both heating and cooling periods. This, in fact, was the principal reason for the change over. What we were not so sure of at that time was the life of these linings. We would hardly have dared to expect anything as good as we got. The second picture shows the same roof after *five years'* service. So far as we can see it is good for at least another five years and probably longer.

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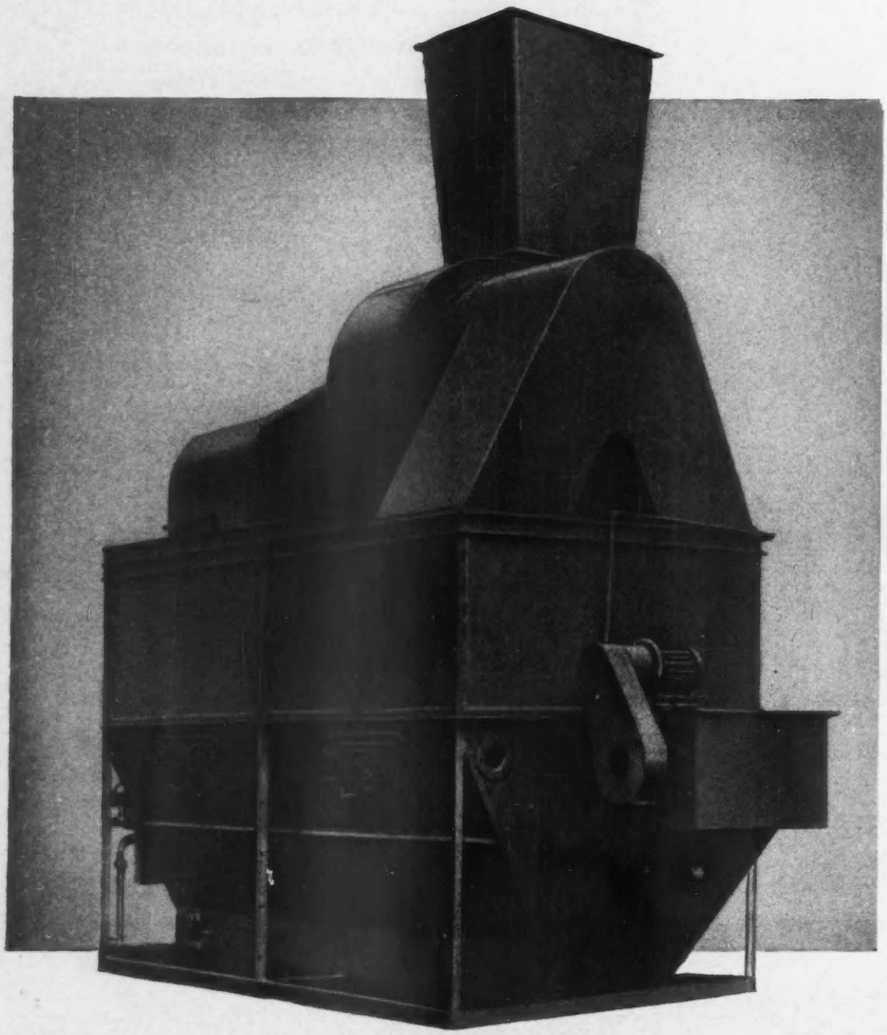

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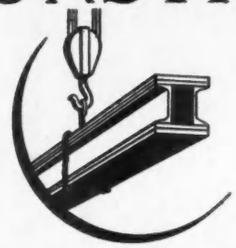

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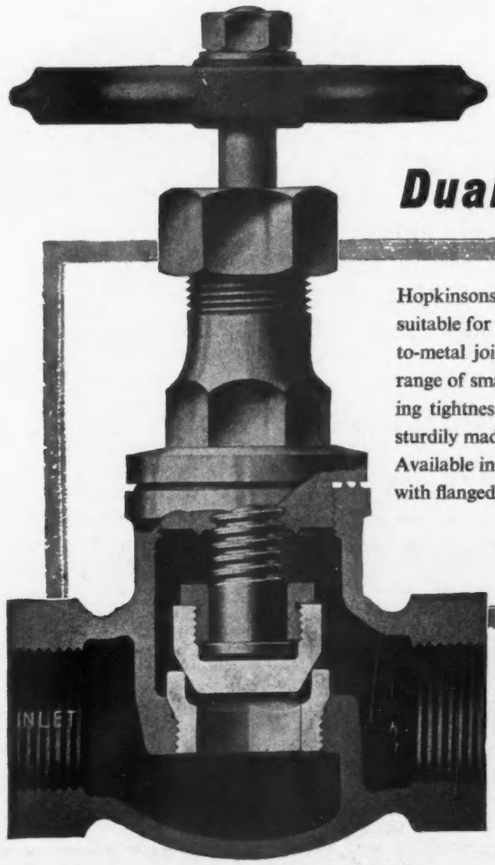

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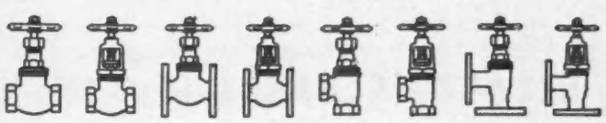

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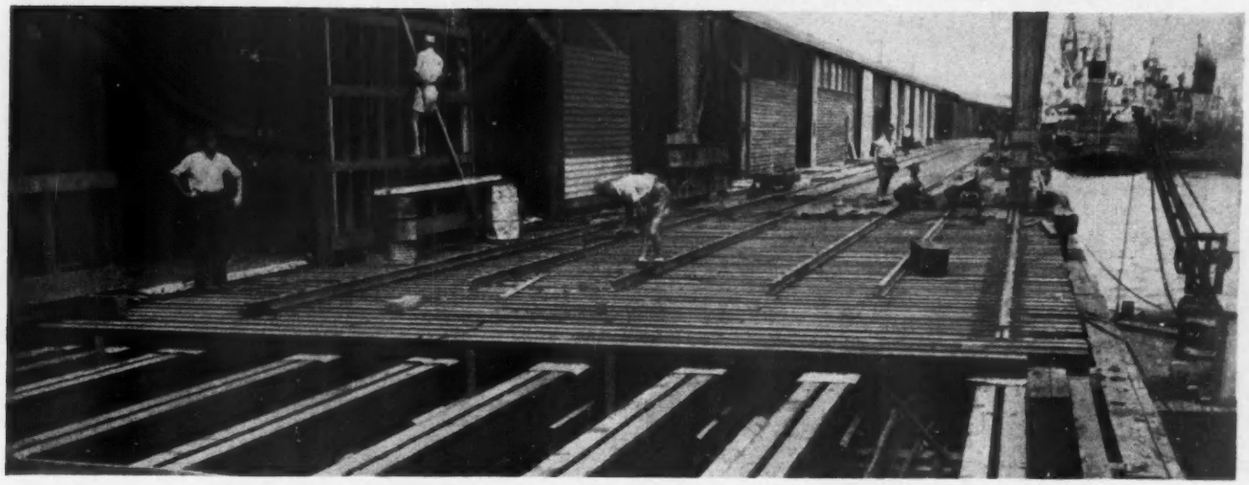

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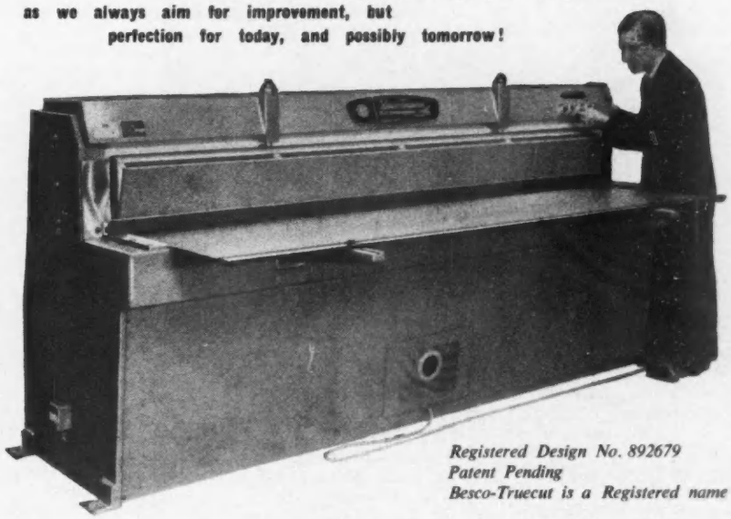

Registered Design No. 892679
Patent Pending
Besco-Truecut is a Registered name

are the result of entirely fresh thought in guillotine design featuring an electrically operated self-adjusting friction clutch and magnetic brake with worm gear drive, giving vibrationless and almost silent and maintenance free performance. Bed, frames and base are of steel plate, welded as one unit with no outside moving mechanism. Many other distinctive features crown this superb range of electro-mechanical guillotines.

Made in sizes to cut up to:
4ft., 6ft. and 8ft. wide × 14 S.W.G. and
3ft., 4ft., 6ft., 8ft., 10ft. wide × ¼in. and 8ft. × ½in. mild steel

Excellent terms: monthly account, hire purchase, or The F J E Machine Hire Plan.

Designed and built by Britain's leading makers of Sheet Metal Working Machines . . .

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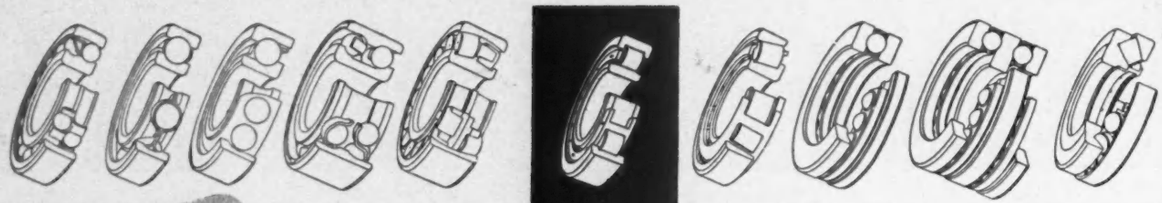
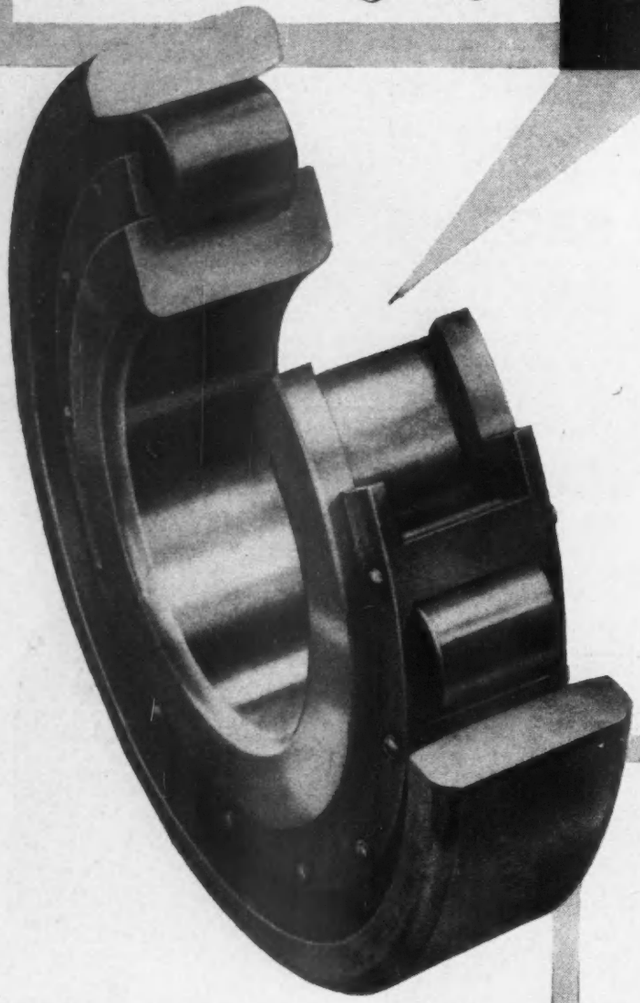
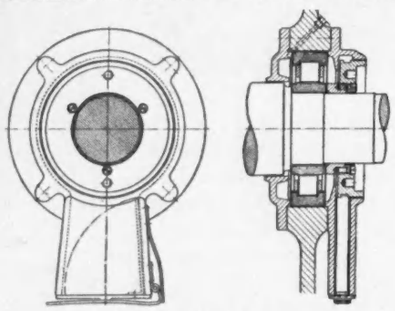




Illustrated on the left is the SKF cylindrical roller bearing, one of the ten variants of the four basic types of rolling bearing manufactured in Great Britain by The Skefko Ball Bearing Co. Ltd. The cylindrical roller bearing has a low coefficient of friction and is therefore suitable for shafts operating at high speeds. Because of its high radial carrying capacity it is extensively used in electric motors, gearboxes and similar applications.

Behind every SKF bearing lies unrivalled experience in the design and application of rolling bearings all over the world. This experience is at your disposal from any one of Skefko's twenty Branch Offices, situated at strategic points all over the British Isles.



Bearing housing for an electric motor, incorporating a cylindrical roller bearing and a grease valve.

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G 170

ENGINEERING Impact

of Too Costly Consultants

CONSULTANTS are being shot at from behind. Anyone acting as a scout—whether he is a cavalryman or a consulting engineer—must not be surprised if some of the rounds fired at him come from his friends in the rear.

That is exactly what is happening to consulting geologists and engineers in the mining world. They are said to lack the resources necessary for ensuring that in overseas markets British manufacturers of mining equipment obtain orders as a result of the consultant's preliminary study of a mining scheme. The consultants are available and they know their job, but they are up against foreign consultants who, by devious means, quote a subsidised fee wherever this is advantageous either to national political strategy or to the mining machinery manufacturers.

The criticism is made by Mr. C. R. C. Burton, who is chairman of the newly formed British Mining Equipment Export Association. He says that it is essential that "British consultancy know-how be made available at a competitive cost and at the earliest stages of all new exploration and mining projects."

Thirty-three well known mining equipment makers are members of the Association, and they envisage mutual cooperation in overseas market intelligence and sales promotion activities.

Consulting civil engineers suffer from a different obstacle. They must battle against an ignorance in high places abroad as to the true functions and value of a first-rate independent consulting engineer.

There is no evidence that potential clients in the underdeveloped countries have been given chapter and verse on the benefits of employing a consultant. Instead of vague generalisations and clichés in conventional publicity material some real case histories would do a power of good for British industry—and its customers.

A Clear Picture of Television

The Post Office and the national Press went to town on the recommendation of 625-line television by the Television Advisory Committee. This technique would give only marginal improvement over the present 405-line transmission. What really matters to both industry and viewer is the technique to be adopted to give a greater number of programmes.

For many years now certain television manufacturers have been arguing that Britain should abandon the 405-line picture system and fall into line with other countries who are now using a 625-line technique. There are two main advantages to such a change; the first is that it would slightly improve the picture quality, and the second is that international television links could be made more easily and effectively.

However, the reason for the manufacturers interest may be tied up with the fact that they are somewhat handicapped in their export trade by having to make one type of equipment for the home market and another for overseas. It could also be said that manufacturers would benefit marginally from such a change in that old sets may be scrapped before their time when the new system comes into operation; although the two systems would probably work side by side initially so that viewers with old sets would not have to buy new ones immediately.

The recent report by the Television Advisory Committee, which recommends the change to 625 lines, points out that Bands IV and V will have to be used in the future if we are ever to have more than three programmes. Therefore, they say, if the present Bands I and III must be abandoned for this reason, it would create an opportune moment for adopting the higher definition system. They also point out that it would be quite possible to have up to seven programmes on the present 405-line system simply by changing to the higher frequencies of Bands IV and V.

It is apparent that the real crux of the matter is not that of marginally improving the picture quality with more lines, but whether or not we should adopt Bands IV and V to increase our programme capacity. By going to these higher frequencies many technical problems will be raised and the cost of both receivers and transmitters will go up appreciably.

Taking Contracts Overseas

Constructional work in the underdeveloped countries is running at a higher figure than ever before. Loans from the World Bank alone amount to $1,570,000,000 and the greater part of this is directed towards major capital works.

Despite these loans, throughout Africa, and probably many other areas as well, there is the constant cry of "contractor finance." Everywhere there is a demand for capital works, but very little accumulated capital to pay for the work. Overseas a contractor tackles the whole job and relatively little is hived off to sub-contractors. His responsibility for the labour force is vastly more involved than here at home. However much plant might be taken to an overseas site, the basic cost of labour is so different from, say the United States or Western Europe, that an entirely different design may be economical than from one justifiable in an area with high labour costs.

None of these points is obviously on the agenda for next week's conference at the Institution of Civil Engineers on civil engineering problems overseas. The papers to be presented are, for the most part, concerned with particular jobs. Yet out of them the delegate will have to distil lessons that are generally applicable. As at so many conferences it will be the conversations outside the lecture hall that will be especially valuable.

Nearly 200 members are expected at this the Institution's seventh annual conference on overseas work. During the week a lunch is to be given at the Institution in honour of Dato' Abdul Razak, the Prime Minister of Malaya. At the lunch the President of the Institutions will be supported by the Presidents of the Institutions of Electrical and Mechanical Engineers.

of Queen Size Capital Commitment

A man who hires a deckchair may feel inclined to go on sitting in it notwithstanding the onset of a downpour. He has paid his money and wants to get his money's worth. The man who buys a machine tool, nuclear power station or ocean liner is subject to an equally compelling feeling. He must secure the maximum return on capital invested, and hence must keep his purchase in full and constant use. In recommending a replacement for the Queen Mary, the Chandos committee must have been very conscious that to recover so enormous a financial outlay, it would be necessary to operate the vessel at maximum load factor. The proposed upper financial limit for the new vessel is £30 million, of which £18 million is to be lent by the Government, the remainder being subscribed by Cunard. The liner France, launched recently, will cost £27 million, of which 20 per cent, or £5½ million, will come from government sources. The proposed Cunard liner will be 75,000 tons gross—nearly twice the total tonnage of all export orders received in the first quarter of the year. Of greater displacement than the, France, she will carry more passengers, but will be shorter overall. (ENGNG., 20 May, p. 702, "The Optimum Size of Ocean Liners.")

	Queen Mary Replacement	*France*
Tonnage gross ..	75,000	65,000
Length overall ..	990 ft	1,035 ft
Beam	114 ft	110 ft
Draught	30 ft 3 in	34 ft 6 in
Speed	29½ knots	31 knots
Passenger capacity	2,270	2,000

So big and costly a vessel cannot be kept idle. It must be operated on base load, like a nuclear power station, and consequently may be filled with passengers at the expense of other ships or transport, as less favoured power stations are compelled to carry the less economic loads. Subsidised construction may thus be followed by an operating subsidy. (On the other hand, the surplus demand for passages in the famous and luxurious super-liner may be channelled into other ships, with operating advantages all round.)

For engineering the influence of capital commitment is very marked. The whole balance of production may, for example, be disturbed by the need to keep a single costly machine tool fully occupied. The production engineer, like the operator of a shipping line or the power programme planner, has to make a choice: should all machines be employed in proportion to their initial cost, or should the utilisation of each unit be solely determined by the requirements of the overall process?

Please Buy Our Soviet Machinery

The future prospects of Anglo-Russian trade are uncertain and complex.

If the United Kingdom were to accede to Soviet requests and increase the quota for machine tool imports to this country, the reaction from the home machine tool industry would not be long in being heard. The wrath of the oil interests if the Government gave way to Russian desires to send substantially more of their oil surplus to Britain would be considerable.

And yet there are advantages hidden behind what may be seen by special interests as threats. Why do the Russians seek to trade? It would be a very odd business if they wanted to set up working arrangements merely for the fun of causing the dislocation of smartly cancelling them again.

What Russian trade representatives have repeatedly said is that they want to earn money in this country in order to buy raw materials in Commonwealth countries. And such purchases in the basic producing Commonwealth countries plainly would create further opportunity for British sales in those markets.

An increased machine tool quota for the Soviet industry would only be taken up by British industrialists if the tools were specially suited to their needs. And the results could well be products made more competitively for the export battle. If dumping of tools were thought to be taking place it would not be beyond the wit of the Board of Trade to put a stop to it.

Naturally enough the oil companies would dislike a significant increase in Russian oil imports by Britain. They are already committed elsewhere. They must not be surprised if the consumer notices that the Russians offer their products at between 10 and 20 per cent below market prices.

Soviet oil exports to Scandinavia and Italy have produced some lively price cuts in those countries. In the United Kingdom, the Soviet Trade Delegation pursuing its talks on the annual review of last year's Five Year Trade agreement, will have pointed this out. And it is talking to representatives of a Government expressly dedicated to reducing or at least stabilising the burden of costs.

and Boom Conditions in Iron Foundry Output

Not for five years have the iron foundries operated at such a high level of capacity. The still increasing demand from a broad front in industry means a lengthening in delivery dates to as much as nine months in some cases.

More cheerfully the ironfounders are intensifying efforts to bring in the most advanced plant and to step up the number of craft apprentices.

The breakdown of the first quarter's figures for the year yields nothing but optimism. The demand from engineering was up by 6·5 per cent over the last quarter in 1959—to 330,200 tons. This was a fifth more than the first quarter of last year. Even the demand for castings for railway equipment. which now accounts for only 6·4 per cent of the total, was up by almost a tenth on the previous quarter.

The automobile section, which includes tractors, increased over the previous quarter by 4·5 per cent to 201,600 tons. This is almost a third more than 1959's first quarter. The demand for castings for pressure pipes and fittings was slightly down, by 0·7 per cent, and the quarter was 31·0 per cent better than the same period of last year. The building and domestic section demand was also reduced, by 2·5 per cent, and this part of the market is only up on the first 1959 quarter by just above a tenth.

Materials for High Temperature Furnaces

Meet tungsten, molybdenum, tantalum and graphite... they will be useful when designing a high temperature vacuum furnace.

GREAT care has to be taken in choice of materials for the elements and shields of furnaces working at temperatures above 1,000°C. There are advantages both metallurgically and in designing when these are operated under vacuum, and this branch of furnace design is firmly established. The obvious advantage is that a metal such as molybdenum, which oxidises above 700°C when heated in air, is satisfactory up to at least 1,800°C in vacuum. However, it is not quite as simple as choosing a metal which melts at a high temperature. Some of the things that must be thought about are listed in the box.

Internally heated furnaces can be used up to temperatures of 2,500°C given the right materials. Four designs of such furnaces made by Wild-Barfield, one in collaboration with NRC in the USA and the other to Degussa patterns, are shown below with their operating details and materials of construction.

Materials widely featured in high temperature vacuum furnaces are molybdenum, tantalum, tungsten and graphite. The top temperature at which they can be used as elements can be judged on the three basic requirements of strength, resistivity and vapour pressure, rough values of which are shown in the illustrations. Where vapour pressure is the limiting factor, it is possible to push up the top limit by backfilling with an inert gas. So long as the vapour pressure is kept below the pressure of this gas, the evaporation rate will be low.

For a loss in weight of thin sheet of about 1 per cent at a pressure of 10^{-4}mm Hg, it is reckoned by the furnace trade that the limit for molybdenum is about 1,900°C, for tantalum 2,400°C and for tungsten 2,600°C. Graphite panels are satisfactory way above 2,500°C, but it is wise to watch the vapour pressure, and backfilling with inert gas will be required above 2,000°C.

Poisoning of metals with vapours is not easy to predict but can lead to formation of a liquid phase, such as between molybdenum and chromium which melts at 1,650°C. Graphite is the least sensitive material to vapours, but its own vapour is objectionable in treating some reactive metals such as uranium. Some metals are sensitive to thermal embrittlement even in the absence of vapours. Thus molybdenum and tungsten lose virtually all their ductility after heating above 1,500°C and care must then be taken in handling elements and shields to ensure that the metals are not shattered. Tantalum is the one metal which is self-annealing, and this remains ductile after continuous use.

The grade of graphite used by Wild-Barfield for heating elements is one with a low ash content of 0·5 per cent. Molybdenum, tungsten and tantalum are readily obtainable from manufacturers in this country or from continental suppliers.

Of the four materials suitable for high temperatures, graphite is the cheapest, with molybdenum in second place. Tantalum and tungsten are very expensive.

Two types of construction are widely used for internally heated furnaces: wire supported in a cage structure on ceramic insulators, or an all-sheet construction. The temperature limit on pure alumina insulators is about 1,700°C, and above this, metal spacers and supports must be used, preferably of the same metal as the heating elements. The actual wire is doubled up at the exit points to reduce the heat dissipation in these areas.

For temperatures above 1,800°C, even the refractory metals can barely support wire heating elements and prevent them sagging or shorting over. It is then time to consider a sheet element. With circumferential corrugations on a cylindrical element it is possible to work to the top limits of tungsten and tantalum mentioned earlier. Graphite resistor panels are assembled without any ceramic supports, with graphite busbars and with machined joints.

Favoured insulation shielding is multi-sheet metal with intermediate vacuum spaces. Examples in the furnaces below are typical of what the trade considers optimum. Use of ceramics is possible but rare, primarily because of outgassing. There may well be a future, though, for composite panels of foamed alumina and metal, since, although very expensive, this refractory outgasses very quickly.

DEMANDS ON ELEMENTS, SHIELDS, ELECTRICAL INSULATORS . . . .

Strength:
Self-supporting at operating temperature

Ductility after heating:
Materials which become brittle may shatter when changing elements

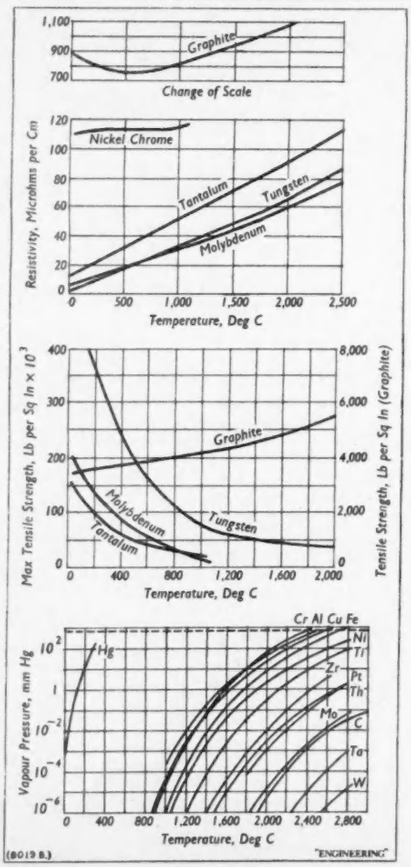
Compatibility with other materials:
Avoid combination of solids and vapours which form low melting point constituents

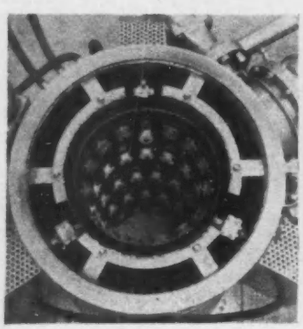
Low emmissivity:
Will reduce heat loss through shields

Low vapour pressure:
Keep lower than furnace vacuum or evaporation losses will be high

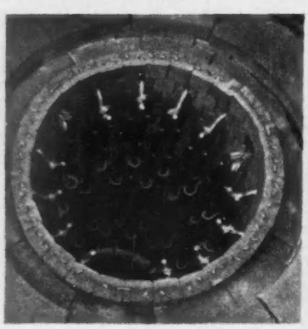
Weldable and formable:
Metals should be weldable and sufficiently ductile for forming into elements, etc.

Resistance of elements:
For operating at convenient voltages and to permit easy control choose high resistivity material with low positive coefficient. Use thin sheet or long wire. Avoid materials whose characteristics change

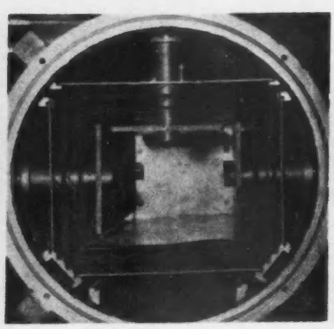




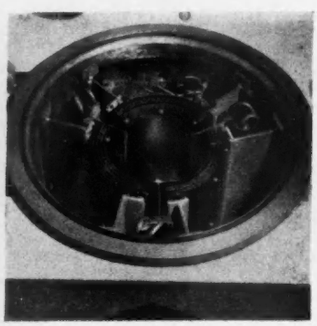
Temperature	1,300° C
Vacuum	10^{-5} mm Hg
Power	30 kW
Charge size	7 in dia. × 24 in high
Element	molybdenum wire
Supports	pure alumina
Shields	4 molybdenum, 3 stainless steel
Makers	Wild-Barfield



Temperature	1,800° C
Vacuum	0·1-1·0 mm Hg backfill with hydrogen
Power	60 kW
Charge size	7 in dia. × 21 in high
Element	molybdenum wire
Supports	molybdenum
Insulation	inner zirconia, outer magnesia
Makers	Wild-Barfield/Degussa



Temperature	1,600° C (2,000° C with more power)
Vacuum	10^{-6} mm Hg
Power	30 kW
Charge size	7 in × 5 in × 12 in deep
Element	graphite
Shields	5 molybdenum corrugated; outer, S. steel
Makers	Wild-Barfield



Temperature	2,500° C
Vacuum	10^{-5} mm Hg
Power	60 kW
Charge size	6 in dia. × 10 in high
Element	tungsten sheet
Shields	3 tungsten, 3 molybdenum
Makers	Wild-Barfield/NRC

Intermediate Plate Aids Diffusion Bonding

Diffusion welding has been found possible at low temperatures when an intermediate metal, such as is applied by plating, is present between the surfaces.

Intermediate metals make it possible to make joints at temperatures far below those which would be required if two pieces of metal were pressure bonded directly to each other. In some cases, the layers provide a further advantage: they can reduce the need for deformation during bonding.

Such diffusion bonding processes have been applied to a number of problems at the Battelle Memorial Institute. One application was in the development of a method of making a throat block for a very high speed wind tunnel out of Monel metal and beryllium-copper. The block itself was made of Monel and had cooling grooves cut in its surface. A sheet of beryllium-copper had to be attached to this to cover the cooling grooves.

While the two metals could be attached by brazing, problems were encountered in trying to heat treat the sheet to the strength level required. By using copper and silver as intermediate materials in the joint, excellent bonds were obtained at 650° F. Since this was the age hardening temperature for the beryllium-copper, the required strength was obtained in the cover sheet at the same time it was bonded to the block. Moreover, bonding at this temperature avoided distortion which was encountered when brazing was used to attach the cover sheet. Joints obtained in this application had very high strengths and in other applications diffusion bonded parts have been used at temperatures well above the bonding temperature.

Battelle Memorial Institute, 505 King Avenue, Columbus 1, Ohio, USA.

Pitch Fibre Pipes

Future growth of the British pitch fibre industry can be "virtually without limit," says Mr. John Ordish, chairman of the Pitch Fibre Pipe Association. The association, formed in 1957, is concerned with pioneering this new and important industry in the United Kingdom. It is significant that all the British manufacturers have increased their productive capacity and another has now entered the field.

They believe that the increasing application of pitch fibre pipes for drains and sewers in this country will be the most important element in growth of the industry. The road building programme affords another opportunity. Present use for cable conduit will be dwarfed in time by its more extensive adoption for electrical power transmission and for telephones.

The association has published a manual under the title *Pitch Fibre Pipes: Information and Data Sheets*, which will eventually provide a complete central source of information about pitch fibre products and their applications.

Pitch Fibre Pipe Association of Great Britain, 27 Chancery Lane, London, WC2.

Quenching Oils with Unusual Characteristics

Quenching oils containing a formulation of wetting oils and other ingredients developed in the USA by Aldridge Industrial Oils, are now being made in this country. The oils are claimed to give greater hardness to oil hardening steels; to give a deeper case quicker and with minimum distortion, oxidation and sludging. In the initial and intermediate temperature range they have increased cooling power, but below 370°C the cooling rate reduces rapidly to permit gradual transition to martensite, thus combining maximum hardness with minimum distortion, strain and cracking. They are particularly economical to use, say the makers, showing little if any deterioration over long periods of hard usage and due to their light viscosity compared with other quenching oils, draining more freely from the work.

Once mixed, the additive, called Quenzine, becomes an integral part of the quench oil and will not separate. It has no preferential dragout, it contains no soaps or fats and is not affected by filters. Quenzine does not hold water but allows moisture to settle and to be drained off from the bottom of the tank.

Now down to hard facts. These oils come in three grades: K9 for use at 130 to 180° F, K150 for 225 to 300° F and K300 for marquenching at 325 to 400° F. K9 gives maximum hardness to tools, cutlery, bearings and other parts heated in any medium including salts and cyanide. K150 is recommended when absence of distortion and cracking are the main considerations. This oil, though producing hardness to a degree and depth comparable with K9, causes no more distortion and cracking than oils and salts used at 350 to 400° F. At 100° F, K9 and K150 have viscosities of 90 and 190 SUS respectively. That of K300 at 210° F is 90.

Electric Resistance Furnace Company Limited, Queens Road, Weybridge, Surrey.

Foil Coil Progress

A gentle but perceptible wind of change has been making its mark on the electrical industry in the past two or three years. A material that has become a household word in other fields, aluminium foil, is finding its way into a steadily increasing number of electrical applications.

Newest of these is the production of electrical coils and solenoids, which Venesta Foils have been making from aluminium for nearly two years. They are being used, in place of conventional copper wire windings, in applications that range from solenoids for heavy electromechanical equipment, to field coils for travelling wave tube and coils, and as an alternative to permanent magnet focusing for television receivers. At an advanced stage of development are aluminium foil coils for transformers, motor car horns and the atomic energy industry.

The main features of aluminium foil coil derive from the fact that windings are rectangular in section and not round as they are in the normal insulated wire coil. Thus, because the windings are in close contact throughout their width, there are no voids between the turns and a high degree of thermal conductivity is maintained throughout. Local hot spots and wide differences in temperature between the centre and ends of the coil are much less likely to occur.

For the same reason, an aluminium coil need be little larger than a copper coil of the same electrical capacity despite the fact that aluminium is not quite so good a conductor of electricity as copper and 1·64 times as much aluminium is needed to achieve equal conductivity. The space factor of an aluminium foil coil determined by relating the volume of conductor to the volume of the coil as a whole is usually about 97 per cent; copper wire coil average about 65 per cent. There is also a weight saving of up to 50 per cent.

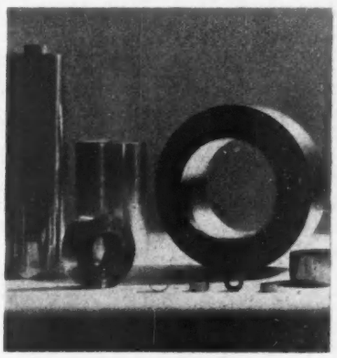
Several methods of insulating foil coils have been tried during their development, including use of insulating materials interleaved with the windings. But the most satisfactory system, combining optimum electrical performance with economy in bulk and weight, has proved to be the application of insulating coatings to foils.

Where a coil is designed to withstand temperatures of no more than 100° C, the coating used is usually a thermoplastic varnish based on a pvc resin. For higher temperature operation, thermosetting varnishes of the epoxy type, stoved at about 180° C, have been found more reliable.

Coils designed to operate at extremely high current loadings and temperatures have to be provided with accelerated cooling. Several methods—water jackets clamped to each end of the coil, forced air draughts and even total immersion of the coil in water—have been developed.

Foil wound coils, after curing, are rigid enough to keep their shape without the use of end supports or cheeks. They are normally wound to a tolerance on the length dimension of 0·015 in, but much greater degrees of accuracy can be achieved where necessary.

Here, the foil strip wound on to the coil core is at least one-sixteenth of an inch wider than required and is machined down to the correct dimensions on a lathe. The machined ends are mildly etched with acid, leaving the insulation slightly proud and removing any burring that might cause short-circuiting between the foil turns, and the coil is then end coated and cured for the second time. In this way, Venesta have found it possible to produce coils with length



Electrical coils made from aluminium foil.

dimensions guaranteed to plus or minus 0·002 in.

Most of Venesta's experience to date has been in the production of coils and solenoids for direct current operation. In recent months, however, considerable progress has been made with foil windings for the more demanding a.c. applications, notably in development of foil wound coils produced with both ends etched and a double varnish coating to insulate the windings. The double treatment counteracts stresses that occur in a.c. coils of less than 500 turns and enables them to work at 1,000 volts and more.

The method of manufacturing aluminium foil coils is extremely flexible. There are normally fewer restrictions on the designer than when conventional wire coils are being used. A present, Venesta Foils are equipped to offer aluminium coils of lengths from $\frac{1}{16}$ in to 16½ in and outside diameters from 1½ in to 19 in. Foil conductors are available with cross sectional areas of between 0·003 sq. in and 0·168 sq. in. And, with demand increasing steadily, the company envisage future production of fully insulated foil in any reasonable cross-sectional area and any width up to 28 in.

Venesta Foils Limited, Vintry House, Queen Street Place, London, EC4.

200 Ton Steels are Ductile

The Ford Motor Company of Dearborn, Michigan, have been working on high-strength steels in their research laboratory, according to Mr. Victor G. Raviolo, executive director of the company's engineering staff. In the past, ultra-high strength steels were known as laboratory curiosities. They had been very expensive and, characteristically, too brittle for most applications. The company have now made steels of 400,000 to 500,000 lb per sq. in tensile strength with elongations of 7½ per cent.

Preliminary studies indicate that these steels can be made at reasonable cost in large volume production. It is not yet certain whether these steels can be used for working parts, but Ford are confident they will find a place in automotive design. Mr. Raviolo was speaking on "Automotive Development Trends in the USA" at the Institution of Mechanical Engineers.

Plain Words

By Capricorn

I AM told that the thinly disguised hostility between people in sailing yachts and people in motor cruisers is coming out into the open now that the coastal waters of our island are becoming filled to capacity.

The man who sails silently by the wind takes a poor view of him who cleaves his way through the water by internal-combustion power. Because of my engineering associations—not in spite of them—I agree with the man who likes to watch the wind in a sail.

Never in the history of Britain have so many men acquired some proficiency with boats. There is no place in England farther than seventy miles from the sea and there are many stretches of inland water where there is sailing and boating for enthusiasts and holiday-makers. But there is a fundamental difference of outlook between the man who goes on the water to "get away from it all" and enjoy the delights of a simple life, and the man who takes with him all his instincts as a road hog as he sits on a padded seat clutching the wheel and throttle. It is a common sight today—a he's-all-right Jack going flat out in a hired craft that is probably worth more than his house, bouncing all other boats in range. And written all over his face—the childish conviction that the big engine under his feet makes him superior to other mortals.

This prostitution of the fruits of engineering was, I suppose, inevitable. Civilised, industrialised man is going through a crazy stage. For the first time in history he has personal machines and he is like a child with a new toy. Earlier machines were owned by firms or public bodies and were controlled by Factory Acts and so forth. The only personal machines were the expensive motor-cars, but they were controlled by decorous chauffeurs for gentlemen of quality.

Now—we must face it—we have entered the age of the common machine for the common man. And what a noisy horrible machine it often is. Not only motor boats but also the long suffered portable radio and gramophone, the motor-cycles and scooters and bad-mannered cars.

Can we control these abuses? It seems to be almost impossible. The Noise Abatement Society may do some good but in the end people get the kind of environment they want or deserve, and if the majority like crowds and noise—if they can only find a satisfying life by jostling in a crowd—then the world will be like that for them. As Telford foresaw, engineering is for the use and convenience of man, but he could hardly have foreseen the interpretation that would be put on his words.

There is just one hope—that our children will be unexcited by these toys. Already some of them show signs of being unimpressed by the things that excite you and me. Where we would have asked to go for a run in a car, they ask "Can't we walk to the village, Daddy?"

Letters to the Editor

Helping the British Inventor

SIR, I was most interested to read your article on "Cold Shoulder for the Inventor" (ENGNG., 27 May '60, p. 717), based on a partial survey of membership of the Institute of Patentees and Inventors. For two years I have been trying to get details of their members' patents available for licensing. These would be published free of charge, with no commissions of any sort for the benefit of some 2,000 companies receiving my journal.

Although equivalent bodies in Sweden, Switzerland, Germany and the United States forward their licences I fear I still receive none from the British Institute.

Your faithfully,
KENNETH MASON.

Raggleswood, Goldrings Road,
Oxshott, Surrey.
30 May, 1960.

Speaking Our Minds

SIR, Capricorn's Plain Words (ENGNG., 27 May, '60, p. 712) expose the need for freedom of expression in technical development—when in the Civil Service I was not allowed to read a paper to the British Association on farming, while engaged on aircraft instrument design, without resigning first. The statistical analysis of inventors' records (p. 717) proves that invention must be adequately sponsored up to that stage where busy industrial executives can tell at a glance whether an invention is viable. British inventors have brought themselves into rather bad repute by failing to work up their ideas to the stage whereby they can be neatly "placed" in current industry. Instead, they become sponsored by other nations and are subsequently bought back to this country at a high price.

My impression is that when the National Research Development Corporation does take over an invention ample funds are provided.

There follows, however, the danger common to all Government departments that the development becomes screened from all external criticism —which is not a good thing. Few inventors obtain this official backing, owing to the difficulty of meeting NRDC requirements in respect to projected costings, efficiencies and development schedules; quite normal requirements for Government departments but ones extremely difficult to meet by an inventor working on a difficult subject.

Therefore, in my opinion, there is very great need for some intermediary body, such as the Institute of Patentees and Inventors, to assist the free-lance inventor to bring his work up to that high standard whereby NRDC or large industrial firms can readily take over, a body which, moreover, can subsequently hold the necessary watching brief over the final stages of development, thereby preventing its becoming the subject matter for "empire building," which is all too common in Government departments.

If we are inventors at all, it is we who shape the future, but the calling is a very high one and generally our training, experience and financial backing are much too meagre. Highly specialised advice in law, commerce, publicity, science and engineering become imperative, at every turn, to ultimate success. If we wait to acquire these abstruse skills ourselves we stand to lose that priority over other countries upon which not only our identity rests, but that of the nation at large. Upon Britain's smooth transition from a great military power to the far greater power gained by rendering service to human need much of the world's security rests.

There is, then, a grave responsibility which must be shared between inventors and the nation. Between them, they must provide for that efficient central body to assist the inventor to work up his ideas, whereby the State or industry can take over. That body will execute quite half the work of getting an invention up to its "economic take-off stage." In my opinion, therefore, that body should draw its funds from both inventors' profits and the public purse, say 25 per cent from inventors' profits and an equal sum from the Government. Administration should be equally shared between inventors and State officials.

But to prevent the present fatal drift of British inventions overseas for their development, would it not be possible, through the excellent offices of your journal, to obtain some consensus of opinion from your readers on this most vital subject?

Yours faithfully,
ARTHUR W. CAPPS.

Edgcumbe,
Crowthorne, Berks.
30 May, 1960.

India's New Steelworks

SIR, In your comprehensive report about India's new steelworks at Rourkela (ENGNG., 18 Mar. '60, p. 390) you denote this plant repeatedly as built by German firms, without any indication that most of the steelworks proper are of Austrian origin. Although the "Vereinigte Österreichische Eisen und Stahlwerke (VÖEST), Linz" is mentioned once, the uninitiated reader could not suspect from your report, that this firm is not a German one, nor that it is responsible for the LD-part of the steel plant, which, as you write correctly, supplies 75 per cent of the total steel output in this plant.

Without fearing any intention of a new "Anschluss" from the side of your reporter, may I point out that the LD-process was invented and developed exclusively in Austria, namely by the Vöest, Linz, and by the "Alpine Montangesellschaft," Donawitz, Styria; it got its name from the initials of these two towns. The Vöest, especially, has erected during the last years several LD-steel plants in all parts of the world and has many more orders for such works from abroad. In any case, Rourkela is a joint German-Austrian performance.

Yours faithfully,
V. GRABER.

Österreichische Elektrizitätswirtschafts-
Aktiengesellschaft,
Am Hof 6, Vienna 1, Austria.
25 May, 1960.

Events in Advance

World's Industrial Films on Show in Rouen

IT IS difficult to make anything approaching an adequate appraisal of the many technical and industrial films being produced each year throughout the world, in Europe, or even in a single country. Some of these films are of the very highest class, but the existence of these masterpieces is often known only to a limited circle.

In an endeavour to promote a wider knowledge of all types of films produced for industry and science, brief showings of films of this nature were organised in Rouen in 1958 and 1959. The success which attended these efforts has encouraged the Conseil des Fédérations Industrielles d'Europe and industrial organisations throughout Europe to assist in the organising of an International Festival of Industrial Films, and this event is due to take place in Rouen from 4 to 8 October next.

Firms in 17 countries belonging to the Organisation for European Economic Cooperation are selecting films with a view to their submission for exhibition at the festival. Organisations in countries outside Europe are also being invited to take part in the festival, which aims at granting the highest awards for outstanding industrial films. Altogether, it is hoped that high-grade

films from more than 30 countries, and such as are likely to be of special interest to engineers, industrialists and public relations officials, will be available at the festival.

Plans for the future are also being considered and it is known that the organisers of this year's festival are hoping to hold similar events in England in 1961, in Turin in 1962, in Berlin in 1963, and in Madrid in 1964. Additional information may be obtained from the organisers: COMET, Quai de Paris, Rouen, Paris.

Exhibitions and Conferences

American Society for Testing Materials, 63rd Annual Meeting.—Sun., 26 June, to Fri., 1 July, at Chalfonte-Haddon Hall, Atlantic City, NJ, USA. Offices of the Society: 1916 Race Street, Philadelphia 3, Pa., USA.

Electromagnetic Radiation, Conference on Coherence Properties of.—Mon., 27 June, to Wed., 29 June, at the Institute of Optics, Rochester, USA. Sponsored jointly by the United States Air Force, the Optical Society of America, and the University of Rochester. Apply to Miss H. Tobin, Institute of Optics, University of Rochester, Rochester 20, USA.

Military Electronics, Fourth National Conference on.—Mon., 27 June, to Wed., 29 June, at the Sheraton Park Hotel, Washington, DC, USA. Sponsored by the Professional Group on Military Electronics. Organised under the auspices of the Institute of Radio Engineers, Inc. Apply to Dr. Craig M. Crenshaw, Department of the Army, Office of Chief Signal Officer, Research and Development Division, SIGRD-2, Washington 25, DC, USA.

Institution of Electrical Engineers, Summer Meeting.—Mon., 27 June, to Fri., 1 July, in Scotland. Headquarters at the Central Hotel, Glasgow. Institution offices: Savoy Place, Victoria Embankment, London, WC2. Tel. COVent Garden 1871.

Machine Tools and the User, Informal Discussion.—Wed. and Thurs., 29 and 30 June, at the Institution of Mechanical Engineers, London. Organised by the Institution's Industrial Administration and Engineering Production Group, in cooperation with the Education Group. Registration required. Apply to the secretary, Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, London, SW1. Tel. WHItehall 7476.

British Computer Society, Second Annual Conference.—Mon., 4 July, to Thurs., 7 July, in the Sun Pavilion, Harrogate. Apply to Miss D. E. Pilling, Electronic Computing Laboratory, The University, Leeds 2.

Catalysis, Second Congress on.—Mon., 4 July, to Sat., 9 July, in Paris. Further details obtainable from Professor G. Emschwiller, 10 Rue Vauquelin, Paris, 5e.

Electronics and Instruments Exhibition and Convention, 15th Annual.—Thurs., 7 July, to Wed., 13 July, at Manchester College of Science and Technology. Organised by the Northern Division of the Institution of Electronics. Apply to Mr. W. Birtwistle, general secretary, Institution of Electronics, 78 Shaw Road, Rochdale, Lancs. Tel. Rochdale 48759.

Atomic Shelter in Nuclear Wars.—Two engineering seminars: Sun., 10 July, to Fri., 22 July, at Pennsylvania State University, on "Architectural and Engineering Planning Aspects"; and Sun., 24 July, to Fri., 5 Aug., at Pennsylvania State University, on "Structural Engineering and Radiation Shielding Aspects." Apply to Assistant Professor Gifford H. Albright, Architectural Engineering Department, Pennsylvania State University, University Park, Pa., USA.

Physical, Chemical and Biological Methods in the Study of High Molecular Weight Carbohydrates.—Tues., 12 July, to Thurs., 14 July, in the Edinburgh and East of Scotland College of Agriculture, West Mains Road, Edinburgh 9. Registration fee, £1 15*s* 0*d*. Organised by the Chemical Society, Burlington House, Piccadilly, London, W1. Tel. REGent 0675.

Sydney Engineering Exhibition.—Mon., 18 July, to Sat., 23 July, at the Showground, Sydney. Apply to Industrial Public Relations Service (NSW), Pty., Ltd., Box 4962, GPO, Sydney, New South Wales.

Royal Society's Tercentenary Celebrations.—Mon., 18 July, to Tues., 26 July, in London. Offices of the Society: Burlington House, Piccadilly, London, W1. Tel. REGent 3335.

Medical Electronics, International Scientific Exhibition and Third International Conference.—Thurs., 21 July to Wed., 27 July, at Olympia, London, W14. Sponsored in association with the International Federation for Medical Electronics by Electronics and Communications Section of the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, WC2. Tel. COVent Garden 1871. Exhibition organised by Industrial Exhibitions Ltd., 9 Argyll Street, London, W1. Tel. GERrard 1622.

Astronautical Congress, Eleventh.—Mon., 15 Aug., to Sat., 20 Aug., in Stockholm. Organised by the Swedish Interplanetary Society. The main sessions will be held at the Royal Institute of Technology, Stockholm. Offices of congress secretariat: IAF-60, PO Box 5045, Stockholm 5, Sweden.

Non-Destructive Testing, Summer Institution.—Mon., 15 Aug., to Fri., 26 Aug., at Sacramento, Calif., USA. Apply to Asst. Professor George N. Beaumariage, Junr., Sacramento State College, 6000 Jay Street, Sacramento 19, Calif., USA.

Science in the Advancement of New States, International Conference on.—Mon., 15 Aug., to Tues., 30 Aug., in Israel. Sponsored by the Weizmann Institute of Science. Apply to the Scientific attaché, Embassy of Israel, 2 Palace Green, London, W8.

Chartered Surveyors' Annual Conference.—Tues., 30 Aug., to Sat., 3 Sept., at the University College of North Wales, Bangor. Organised by the Royal Institution of Chartered Surveyors, 12 Great George Street, London, SW1. Tel. WHItehall 5322.

British Association Meeting.—Wed., 31 Aug., to Wed., 7 Sept., at Cardiff. Apply to the secretary, British Association for the Advancement of Science, 18 Adam Street, Adelphi, London, WC2. Tel. TRAfalgar 5733.

European Organisation for Quality Control.—Thurs., 1 Sept., to Sat., 3 Sept., at Church House, Great Smith Street, London, SW1. Organised by the British Productivity Council, 21 Tothill Street, London, SW1.

Rocket and Satellite Instrumentation, One-Day Symposium.—Thurs., 1 Sept., at Manson House, 26 Portland Place, London, W1. Organised jointly by the Society of Instrument Technology, 20 Queen Anne Street, London, W1 (Tel. LANgham 4251); and the British Interplanetary Society, 12 Bessborough Gardens, London, SW1. Tel. TATe Gallery 9371.

British Food Fair, Sixth.—Thurs., 1 Sept., to Sat., 17 Sept., at Olympia, London, W14. Organised by the Food Manufacturers Federation, Inc., 10 Mount Row, London, W1. Tel. HYDe Park 2933.

Operational Research Societies, International Federation of: Second International Conference.—Mon., 5 Sept., to Fri., 9 Sept., at Aix-en-Provence, France. Organised by the Société Française de Recherche Opérationnelle, 27 Rue Lafitte, Paris 9e. Apply to the Operational Research Society, 64 Cannon Street, London, EC4. Tel. CITy 1800.

Farnborough Flying Display and Exhibition.—Mon., 5 Sept., to Sun., 11 Sept., at Farnborough, Hampshire. Open to the public on Fri., Sat. and Sun., 9, 10 and 11 Sept., only. Organised by the Society of British Aircraft Constructors, 29 King Street, London, SW1. Tel. TRAfalgar 3231.

Photogrammetry, Ninth International Congress on.—Mon., 5 Sept., to Sat., 17 Sept., in London, under auspices of the International Society for Photogrammetry. Congress director: Colonel J. B. P. Angwin, 18 Cavendish Square, London, W1. Tel. LANgham 1626.

Radio Isotopes in the Physical Sciences and in Industry, Scientific Conference on.—Tues., 6 Sept., to Sat., 17 Sept., in Copenhagen. Organised by the International Atomic Energy Agency. More than 500 scientists from the Agency's 70 member States are expected to attend. Apply to the secretariat, International Atomic Energy Agency, Kaerntnerring, Vienna 1, Austria.

Brno International Trade Fair, Second.—Sun., 11 Sept., to Sun., 25 Sept., at Brno, Czechoslovakia. Organised by the Chamber of Commerce of Czechoslovakia, 8 Václavské náměstí, Prague, Czechoslovakia. Agents: Fairs and Exhibitions, Ltd., 2 Duraven Street, London, W1. Tel. HYDe Park 5421.

Film Congress, International (14th Congress of the International Scientific Film Association).—Fri., 16 Sept., to Sat., 24 Sept., in Prague. Apply to the Scientific Film Association, 3 Belgrave Square, London, SW1. Tel. BELgravia 6188.

Numerical Treatment of Differential Equations, Symposium.—Tues., 20 Sept., to Sat., 24 Sept., at the University of Rome. Apply to Professor A. Ghizzetti, Provisional International Computation Centre, Palazzo degli Uffici, Rome.

Industrial Electronics Symposium, Ninth.—Wed., and Thurs., 21 and 22 Sept., at the Sheraton Cleveland Hotel, Cleveland, Ohio, USA. Sponsored by the Professional Group on Industrial Electronics of the Institute of Radio Engineers, and the American Institute of Electrical Engineers. Apply to Mr. G. E. Hindley, Reliance Electric and Engineering Co., 24701 Euclid Avenue, Cleveland 17, Ohio.

Factory Equipment, Heating, Ventilation and Thermal Insulation Exhibition, Eighth.—Wed., 21 Sept., to Sat., 1 Oct., at Belle Vue, Manchester. Organised by Industrial and Trade Fairs Ltd., Drury House, Russell Street, London, WC2. Tel. TEMple Bar 3422.

Electrical Fair.—Fri., 23 Sept., to Sat., 1 Oct., at Alexandra Palace, London, N22. Organised by Electrical Fairs Ltd., 6 Museum House, 25 Museum Street, London, WC1. Tel. MUSeum 3450.

Public Works and Municipal Services Congress and Exhibition.—Mon., 14 Nov., to Sat., 19 Nov., at Olympia, London, W14. Organised by the Municipal Agency Ltd., 70 Victoria Street, London, SW1. Tel. VICtoria 9132.

Space Navigation, One-Day Symposium.—Fri., 18 Nov., at the Royal Geographical Society, 1 Kensington Gore, London, SW7. Organised jointly by the Institute of Navigation, 1 Kensington Gore, London, SW7 (Tel. KENsington 5021); and the British Interplanetary Society, 12 Bessborough Gardens, London, SW1. Tel. TATe Gallery 9371.

Corrosion Exhibition.—Tues., 29 Nov., to Fri., 2 Dec., at Olympia, London, W14. Organised by *Corrosion Technology*, Leonard Hill House, Eden Street, London, NW1. Tel. EUSton 5911.

Meetings and Papers

Association of Supervising Electrical Engineers

LONDON
Film Display. South East London Branch. Eltham Green School, Queenscroft Road, Eltham, SE9. Tues., 14 June, 7.45 p.m.

BOURNEMOUTH
"Work of the National Inspection Council," by E. J. Sutton. Bournemouth Branch. Grand Hotel, Firvale Road, Bournemouth. Mon., 13 June, 8 p.m. (Alteration of date.)

British Road Federation

LONDON
"The Merits of Limited Access Highways in Urban Areas," by Fred Burggraf. Royal Society of Arts, John Adam Street Adelphi, WC2. Fri., 17 June, 5.45 p.m. (Tickets required.)

Institute of Petroleum

LONDON
"Exploration and Production Methods: A Symposium"; comprising "Geophysics Today," by Dr. J. McG. Bruckshaw; "Possible Improvements in Drilling," by H. D. Fanshawe; "Advances in Well Logging," by P. Threadgold; and "Partial Removal of H_2S from Crude Oil by Stripping with Natural Gas," by T. R. Shipster. Exploration and Production Group. Fri., 24 June, 10 a.m. and 2.30 p.m.

Institution of Civil Engineers

LONDON
Conversazione. Wed., 15 June, 5.30 p.m.*

Institution of Electrical Engineers

LONDON
Conversazione. Royal Festival Hall, South Bank, SE1. Thurs., 23 June, 7.30 p.m.

Institution of Mining and Metallurgy

LONDON
Various short papers. Geological Society, Burlington House, Piccadilly, W1. Thurs., 16 June, 5 p.m.*

Manchester Statistical Society

MANCHESTER
Annual General Meeting. Manchester Reform Club, King Street, Manchester. Wed., 15 June, 5.30 p.m.

Royal Institution

LONDON
"The Strength of Solids," by Professor A. H. Cottrell. Wed., 15 June, 9 p.m.

Royal Meteorological Society

LONDON
Various short papers. Wed., 15 June, 5 p.m.*

Royal Society

LONDON
"The Nature of Central Inhibitory Action," by Sir John Eccles. Ferrier Lecture. Thurs., 16 June, 4.30 p.m.*

The address and telephone number of the headquarters of each institution are given below. Meetings in the headquarters town are held there unless otherwise stated. An asterisk (*) is placed where it is understood that refreshments are available prior to the time stated.

Association of Supervising Electrical Engineers, 23 Bloomsbury Square, London, WC1. (LANgham 5927)
British Road Federation, 36 Manchester Square, London W1. (Tel. WELbeck 0221)
Institute of Petroleum, 61 New Cavendish Street, London, W1. (LANgham 3583)
Institution of Civil Engineers, Great George Street, London, SW1. (WHItehall 4577)
Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, WC2. (COVent Garden 1871)
Institution of Mining and Metallurgy, 44 Portland Place, London, W1. (LANgham 3802)
Manchester Statistical Society: Industrial Group. Apply to Mr. T. J. Lunt, Ferranti Ltd., Hollinwood, Lancs.
Royal Institution, 21 Albemarle Street, London, W1. (HYDe Park 0669)
Royal Meteorological Society, 49 Cromwell Road, South Kensington, London, SW7. (KENsington 0730)
Royal Society, Burlington House, Piccadilly, London, W1. (REGent 3335)

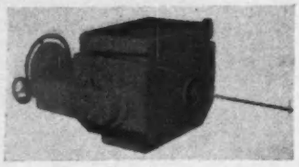
MOBILE BETATRON

Steel Radiography

THE Siemens 15 MeV mobile betatron can be used for X-ray testing of steel fabrications up to 16 in and more thick.

Sections of 6 to 8 in thick require only a few minutes exposure, while a 16 in section would only need 1½ to 2 hours as compared to days for a super voltage X-ray tube of conventional type. Hot workpieces can also be inspected.

The electromagnet is in the form of a shell type transformer with an air gap in the middle leg. The flux produced by the field leads to the emission of electrons which strike a platinum target and give rise to high energy X-rays. The magnet has two rotation symmetrical poles with parallel faces arranged as a two legged yoke, the distribution of the field being governed by pole piles which are clamped between the poles. Both the pole pieces and the surrounding accelerator tube are pneumatically pressed into contact with the magnetic yoke, which gives stiffness and protection during transport in addition to damping down transformer noise and vibration.



The accelerator tube is constructed of a ceramic known as Frequenta, the inner wall being coated with a metallic film. The tube is evacuated to a pressure of 10^{-6} torr. It is sealed with nickel foil through which electrons may escape if free electrons are required. For X-ray work they are made to graze a platinum target fixed to the inner wall of the tube, the resultant rays being taken out through the frequenta wall.

The magnet coils are energised by a regulating transformer connected directly to a 50 cycle mains supply. The consumption is approximately 12 kVA. A regulator is employed to cover mains variations between 180 and 240 volts. The betatron is operated from a small portable control case, and with a total weight of under 3½ tons it may be easily transported from site to site. *Pantak Limited, Vale Road, Windsor, Berkshire.*

CLAMPING NUT

Hydraulically Operated

A HYDRAULIC clamping nut allows very high forces to be exerted without the corresponding torque strains that are caused by tightening with a spanner.

The nut is slightly larger than a standard article and is made in a variety of sizes to cover all threads with diameters from ⅞ in to 2 in. It is screwed on by hand until tight and then the pressure screw is tightened with an Allen key. Tests have shown that with a 1 in nut pressures of 4 tons per sq. in can be obtained, whereas the greatest obtained by tightening with a spanner 16 in long and a hammer was 2 tons per sq. in. Removal of the nut was as effortless.

The body of the nut is made of high tensile steel with an annular recess in the front face. This recess communicates with a bore passing through to the rear face, the bore being threaded to receive a reducing bush accommodating the pressure screw. Recess and bore are filled with a special compound and sealed. A thrust ring fits in the recess,

bearing against the front seal, and a pressure pad bears against the rear seal and transmits the pressure applied by tightening the screw.

A typical example of use of the nut is on the arbor of a milling machine where the elimination of strains imposed by spanner tightening removes risk of damaging the arbor and bearings. The amount of pressure that can be applied can be limited by adjusting the length of the pressure screw. *Euco Tools Limited, 44 London Road, Kingston, Surrey.*

MOBILE WELDER

200 Ampere Rating

THE AS200 is a mobile welder that can provide welding currents from 30 to 375 amperes with a continuous rating of 200 amperes.

The unit is driven by a Ruston and Hornsby 2YWA air cooled diesel engine developing 21 b.h.p. at 2,000 r.p.m. The generator supplies uniform welding current for metallic arc welding with bare or heavily coated electrodes, also for carbon arc welding.

The open circuit voltage can be adjusted in a continuous sequence by means of a shunt field rheostat, while control of the welding current is accomplished by adjustment of both the series and shunt fields. Wing nuts are provided for the easy change of polarity, mounted on the panel with the controls. The generator is mounted directly on to the engine housing and is driven by a coupling connected to the flywheel by flexible bushes.

The unit can be supplied as illustrated on four small diameter running wheels, or with two large diameter wheels and

screw jack gear for fast road towing. A pressed steel canopy gives weather protection and allows easy access to the engine and generator. Provision is made for lifting by a single eye placed to give balance. *Lincoln Electric Company Limited, Welwyn Garden City, Hertfordshire.*

GUILLOTINE

Capacity up to ¼ in Plate

THE latest addition to the range of Besco-Truecut guillotines is an undercrank machine with a capacity for plate up to 8 ft wide by ¼ in thick.

The machine is fabricated from steel plate and a feature of the crankshaft design is the multiple bearing arrangement mounted below the bed, with motion transmitted to the cutting beam by heavy cast steel connecting rods. The cutting beam slides are fitted with plastic wear strips with adjustment in the form of gib strips. The plate to be cut is held by a number of separate plungers. The speed of the cutting beam is 35 strokes per minute.

The machine is equipped with a self-contained worm gear drive which has an electrically operated clutch and an electromagnetic brake mounted directly on the shaft. Control is effected by a floor mounted foot switch that can be moved to any desired position. Single or continuous action can be selected by a switch.

Power is supplied by a 10 h.p. 3,000

r.p.m. motor for three phase supply; the control gear is housed in a panel at the side of the machine. There is overload protection on the clutch to prevent damage.

Setting of the plate is regulated by a power operated back gauge with a front view large scale indicator showing the position to within 0·005 in. Control is from the front. The movement has two speeds, fast for approach and slow for final setting. Limit switches give protection to the movement which has a maximum of 24 in. Front and side gauges are also supplied. A centralised one-shot grease lubrication system is used. Overall dimensions are: height, 60½ in; floor space including front and rear gauges, 145 in by 86 in. The weight is approximately 13,500 lb. *F. J. Edwards Limited, 359-361 Euston Road, London, NW1.*

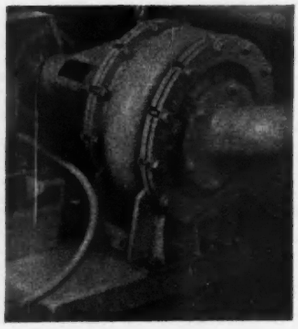
SOLIDS PUMP

Recessed Impeller

THE Torque-Flow pump has been designed to handle most of the difficult materials, such as are encountered in sewage and other waste disposal plants.

The impeller of the pump is recessed clear of the flow of the liquid. Particles are drawn into the swirling vortex, seldom touching the impeller. Even live goldfish can be pumped without harm. Field tests have included pumping effluents containing rags, ropes, hair, rubber, wire, and stones. Paper and wood pulp, crushed bones and shredded hides for the gelatine industry, fruits and vegetables have also been pumped without damage. A special claim is that crystals can be handled without degradation.

The pumps are made in a range of sizes with delivery pipes of 2, 3, 4, 6 and 8 in diameter. Suction pipes are smaller in each case, thus the suction for the 4 in size is 3 in diameter, and for the 8 in is 6 in. Rate of delivery is up to 2,000 gallons per minute for the



8 in model and the total head may be as much as 100 ft.

The pumps in this range are not self priming since they rely on the vortex for operation but when started they can maintain a lift of 28 ft. Very large lumps in comparison with the bore of the pipes can be handled, up to 1⅝ in spheres were passing easily through a 2 in size, although it is recommended that lumps should not exceed half the diameter of the pipe. *George Scott and Son (London) Limited, Levenbank, Fife.*

FLAME DETECTOR

Using Ultraviolet Light

CHIEF claims for a new flame detector are that it can be used on all types of flame or burner and is not affected by hot refractories.

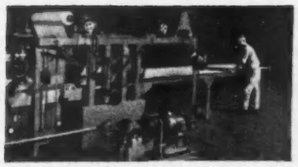
A tube that is sensitive to ultraviolet radiations is used in an amplifier circuit to count the ultraviolet rays present and to add up the impulses of electrical energy generated. An output of 2 microamps from the tube is necessary to prove the flame radiation circuit and to indicate the minimum satisfactory flame condition for safe burner operation. The unit can be used with all fuels including gas-oil combinations, and on multiple burners.

As the tube is sensitive only to ultraviolet the operation is not affected by the presence of hot refractories so that sighting is simple. Exothermic gas generators, flame hardening machines and spark ignition can all be monitored. The system is self contained and simple to instal. It has an ambient temperature rating of 50° to 135° F and can be used on flames up to 2,200° F. Models are

available for operation on 120 or 240V 50/60 cycles supplies. *Honeywell Controls Limited, Toronto 17, Ontario, Canada.*

LAMINATING MACHINE

For Applying Films



THE Contropress now being made in this country is a machine for applying polyester, vinyl and other films to a base in the manufacture of constructional and decorative panelling.

The base material can be plywood, chipboard, asbestos board, hardboard or fibre board or even sheet metal providing that it is properly cleaned. Aluminium copper or stainless steel can also be applied to a wood or board base. Either one or both sides can be coated, an example being for a wall panel which has a central core of plastic foam with on one side a weather proof plastic film to give protection against the elements and a decorative one on the other for the interior finish.

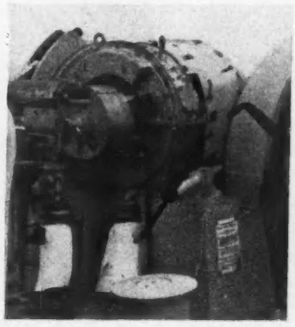
Base panels, prepared by brushing to remove dust and reduce surface defects, are coated with adhesive and dried off without disturbing the moisture balance in the core material. High intensity radiant heaters then preheat the panel as it passes to the press. In the press the laminating film is combined to the base by pressure from a heated roll that is covered with silicon rubber and loaded, hydraulically. The film is pressed into the grain of the wood to give maximum bond.

The panel then passes through another stage of preheat to bring the film to the plastic point to allow final laminating or embossing by a polished chromium plated roll, which also is hydraulically loaded. This gives the film its final texture. Subsequently the film is cut between panels (it is supplied to the machine in continuous strip) and the completed panels run out for stacking.

The Contropress will handle films or foils of various thicknesses, up to 60 in wide, with or without backing papers, for which a take up roll is provided. Output is in the region of 4,000 sq. ft per hour. *Mather and Platt Limited, Park Works, Manchester, 10.*

REVERSING TURBINE

For Deck Machinery



A NEW range of reversing steam turbines has been produced primarily for driving deck machinery such as winches, windlasses or bow propellers.

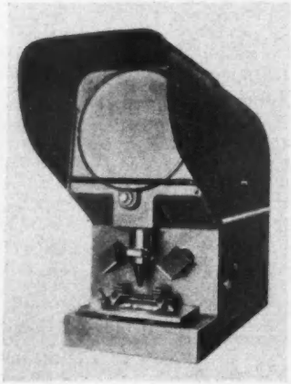
There are four machines in the standard range with powers from 30 to 500 h.p. Speed range of all models is from 1,500 to 4,000 r.p.m. They are designed for maximum steam conditions of 450 lb per sq. in gauge and 600° F. Larger sizes are made (up to 1,000 h.p.) for bow propellers.

Special claims are that the turbines will accept steam direct from the boiler; are self-draining and will accept primary rush of water; the condensate return is free from oil; and the unit is totally enclosed and water tight. The control gear consists of the reversing valve, the governor valve, and a runaway valve if needed. The reversing valve is a balanced piston type providing speed control by steam throttling; operation can be by local hand wheel or lever, or remote with electric, hydraulic or mechanical systems. The governor valves are operated by steam relay, direct, or by hydraulic oil. A trip bolt on the back of the governor flange is used to operate the runaway valve where this is fitted.

The units are silent in operation with rapid acceleration and rapid reversal. They have a smooth torque throughout the speed range. Where necessary a self contained steam released brake can be fitted. *Clarke, Chapman and Company Limited, Victoria Works, Gateshead 8, Co. Durham.*

REFLEX PROJECTOR

Epi- or Diascope Working



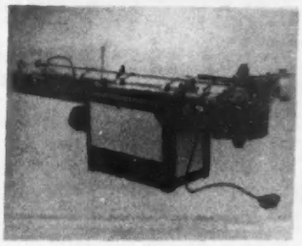
THE reflex projector illustrated has a capacity for work pieces 10 in long and up to 3 in diameter according to the lens used.

The machine is for bench mounting, allowing the operator to be seated in front of it. Particular features are that the lamphouse is behind the work table, and the latter is horizontal so that flat objects can be laid directly on it. The standard stage shown has centres and V blocks with a glass plate for flat items. Alternatively, a coordinate measuring work stage can be fitted, with two micrometer heads reading in 0·0001 in. Travel of the stage is 3 in by 1½ in.

Focussing is by adjusting the projection lens, the stage remaining stationary. The screen is 12½ in diameter and is rotatable through a full circle by a knob placed below it. A vertically adjustable bar crossing the screen provides a rest for form diagrams, for comparison. Three interchangeable lenses are available giving magnifications of ×10, ×25 and ×50. For silhouette projection a 12V 100 watt lamp is used with a raking adjustment to traverse it across the helix angle of a thread. Surface projection is by two 12V 150 watt high intensity lamps. The transformer is built in. *J. E. Baty and Company Limited, Burgess Hill, Sussex.*

TUBE BENDER

Up to 80mm Diameter



THE Mediolanum Mark 2 now available in this country is an automatic tube bender for tubes up to 60 mm diameter in iron or up to 80 mm diameter in alloy. (Approximately 2½ and 3½ in respectively.)

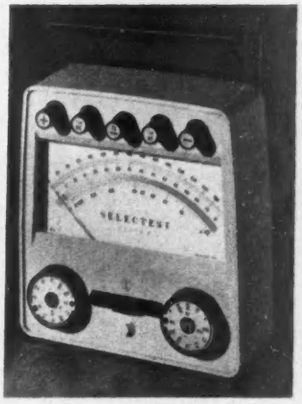
Bends are made without having to fill the tubes and in the cold. The minimum standard inner radius is twice the tube diameter, and the maximum standard inner radius is 8 in. In certain cases it is possible to obtain inner radii smaller than the standard value, or greater than the standard maximum.

The machine is driven by an electric motor of 10 h.p., under foot switch control. All operations are hydraulic from an electromagnetic distributor control. The tube is automatically clamped in position and the rolls or slide are brought into contact also automatically. A device for retracting the mandrel is synchronised with the automatic return of the mandrel to zero. The machine returns to zero when it is stopped. Datum stops on the graduated rotating table allow various angles of curvature in the tube to be obtained without taking it off the machine.

The standard dies supplied are easily interchangeable and special types are available for bending two tubes simultaneously. The maximum working pressure of the machine is from 60 to 80 atmospheres (850 to 1,150 lb per sq. in approximately) and the standard length is 8 ft. Other lengths can be supplied if required. The machine weighs about 2 tons. Automatic safety devices are incorporated and the speed of bending can be adjusted to suit the material of the pipe. *Addison Tool Company Limited, 28 Marshalsea Road, London, SE1.*

MULTIRANGE TEST SET

a.c. and d.c.



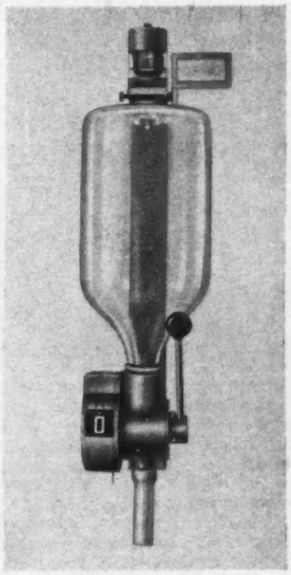
THE Selectest Super K and Super 50 are two new multirange test sets with high performance.

The use of germanium crystal diodes and printed circuits allows a high frequency response and low voltage drops. Accuracy for d.c. voltage and current is within 1 per cent of full scale and for a.c. within 2½ per cent. The frequency range over which accurate readings can be made is from 10 cycles up to 100 kc/s for voltages up to 75, and above that from 10 cycles to 25 kc/s.

The ranges are selected by two rotary switches which are electrically interlocked. The Super K has four a.c. and six d.c. ranges up to 750V and 7·5A with an ×2 switch for all. Three resistance scales give up to 100,000 ohms. The Super 50 has seven voltage ranges up to 2,500V and current ranges up to 10A both a.c. and d.c. Resistance is up to 20 megohms. Sensitivity on the Super K on all scales is 1,000 ohms per volt or 1mA full scale; with the ×2 switch this is changed to 500 ohms per volt and 2mA full scale. For the Super 50 the sensitivity on all d.c. ranges is 20,000 ohms per volt or full scale deflection of 50 microamperes. On a.c. ranges the sensitivity is 2,000 ohms per volt and full scale current is 500 microamperes. *Salford Electrical Instruments Limited, Manchester 3.*

LIQUID DISPENSER

Gravity Feed



THE Mastermeasure is a dispenser for liquids which operates with a gravity feed from a storage tank.

The standard model has a capacity for 1 gallon and is controlled by a handle at the side. The storage tank should be arranged several inches above the dispenser. The connection is through a ¼ in hose.

In the normal position liquid flows from the tank to the dispenser, filling the bottle and the float chamber above it. The rising of the float in the chamber cuts off the escape of air and so stops the flow of liquid. Calibration is by adjusting the position of the chamber connecting tube in the bottle. Pulling the handle forward moves the two-way valve and discharges the liquid to a container below, delivering 1 gallon in 9 seconds. A counter attached to the handle records the quantity issued. The standard unit has a height of 24 in overall and is fitted with a glass bottle. *Lynch Productions Limited, 22 Veryan Court, Park Road, London, N8.*

Electricity Users Force the Supply Pace

It is accepted that more electricity is fundamental to a rising standard of living. But it will also introduce other changes in industry and commerce, for which plans have to be made now.

THE GROWTH of demand for electricity in Great Britain has been at an average rate of some 7 per cent per annum, cumulative, over the last 30 years, and there is no sign of a slackening in the rate of growth; on the contrary, there is every likelihood that it will increase. This rise in the consumption of electrical power is typical of a rising standard of living, and the expressed target of doubling that standard in 25 years can be achieved if the present rate of progress continues.

But meeting the rising demand is not simply a matter of stepping up output. Increased output of any commodity can be achieved by one of two means; multiplication of orthodox types and sizes of machine, or by the introduction of much larger machines or new types—or perhaps both. Production of electricity is, of course, developing in the second direction. Orthodox plants are getting larger, and new types of plant—the nuclear power station—are being built. At the same time methods of distribution are changing, with an emphasis again on bigger equipment. All these changes will not only have the desired effect from the consumer's point of view—more electricity, more reliable supplies and a realistic price—but they will reach deeply into other aspects of industry which do not, at first sight, have any obvious connection with electricity generation and distribution. The impact of increasing electrical supplies on other sections of industry and commerce was one of the features that were discussed at the British Electrical Power Convention held at Bournemouth recently.

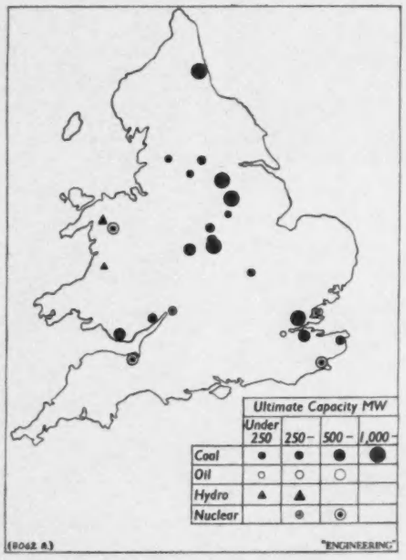
Viscount Chandos, chairman of AEI and President of the convention, stated in his address the theme of the meeting: "Electricity—The New Horizon." He pointed out the doubling of the living standard could not be achieved without doubling the demand for electrical energy. That need has been foreseen by the supply authority, and plans have been made to meet it, but, as Lord Chandos said, the problems involved are many, and can only be solved by commonsense and cooperation throughout the supply industry and the other industries which serve it and are served by it. The scope is endless. Those who think saturation point is approaching have only to look at the underdeveloped countries of the world. Even in the USA, Sweden and Switzerland, the most highly-electrified countries in the world, the growth continues.

PRODUCTIVITY AND EFFICIENCY

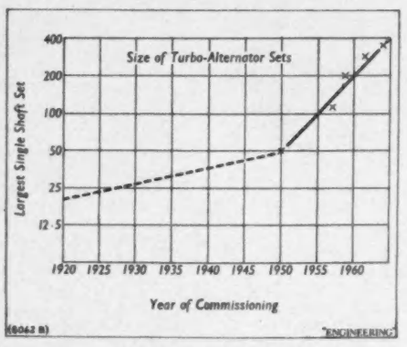
Mr. C. R. King, chairman of the Electricity Council, in his paper "The New Horizon—Electricity Supply" showed that supply had moved in recent years from a two-fuel to a three-fuel industry. In 1958-59 the power stations in England and Wales consumed 42 million tons of coal and 3·1 million tons of oil fuel, equivalent to about 5·5 million tons of coal. By 1964-65 coal consumption is expected to increase by about 8 million tons, and oil consumption by the equivalent of one million tons of coal. By this time the third fuel, nuclear, will provide energy equivalent to about 5 million tons of coal. The sites for planned expansion of generating capacity are shown in the map, where the relative size of the dots indicates plant capacity.

The average thermal efficiency of conventional plant during 1964-65 is expected to reach a figure of about 29·6 per cent, as compared with 26·10 per cent last year. Manpower engaged in operating the CEGB's steam power stations today is approximately 1·5 employees per 1,000 kW of sent-out power, which compares with the figure of 2·8 twelve years ago. The latest stations have something like 0·7 employees per 1,000 kW, and conventional stations due to be commissioned in the next two or three years will have figures as low as 0·3 to 0·4. This has been achieved by the use of larger generating units and the extension of instrumentation and automatic control equipment. Further developments in this field can be expected. At West Thurrock power station the Board are developing complete remote control. If this is successful, the next step will be to employ a computer to control the operation automatically. The gains in productivity are partially offset by the steadily falling hours worked in an average work week.

In the nuclear power field, five stations are under construction and some are due to be commissioned in a year or two. When completed, they will have a total capacity of 2,075 MW and will provide some 10 per cent of the Board's total output. A sixth station has been authorised, and a seventh is under consideration by the Government. More advanced types of nuclear reactor are already under consideration, and looking to the more distant future, there is the more spectacular prospect of the thermonuclear process, based on the energy of fusion when particles of deuterium are combined to form helium. There is also the possibility of development of the magnetohydrodynamic concept, which could render conventional boiler plant and turbo-alternators unnecessary, though this is admittedly a distant prospect.



Sites of new generating stations planned for the period 1959 to 1964.



Growth in size of orthodox generating units.

In the more easily foreseeable future, there is development at present taking place which will have a noticeable effect on another industry, namely, transport. Under certain conditions, it is cheaper to generate the electricity on the coalfields and transmit it to the large consuming centres than it is to send the coal by normal transport to power stations near the points of consumption. A large part of the electricity demand for the London area will be met by current sent from the coalfields area of the Midlands, while Yorkshire will generate electricity for the North West. Similar transfers of current rather than fuel will take place, on a smaller scale, between other areas. This will inevitably have an effect on the traditional fuel transport services—rail and sea. More short rail hauls between pithead and power station will be needed, and less long hauls from the Midlands to the south. Similarly, coastwise shipping of coal will be reduced; it has, in fact, already fallen considerably.

GROWTH IN SIZE

The growth in the size of individual generating units and the development of new types of plant has set problems for manufacturers of equipment which are, as yet, far from being solved. It is well known that the consortia building nuclear stations are losing money on their contracts. This is a matter which will, perhaps, improve as developments continue and experience is gained.

Manufacture of conventional plant sets problems of its own. A few years ago, 30 MW and 60 MW generating sets were regarded as the standard for the industry. Today they are looked upon as very small. In the United States the Tennessee Valley Authority has passed beyond the 550 MW size in a single machine, and has recently placed an order for one of 650 MW capacity. In this country, as Lord Chandos said, the five manufacturers of heavy power plant have a capacity of not less than 7,000 MW a year. The probable domestic demand for new plant is about 2,750 MW a year, leaving 4,250 MW to be exported. If the plants have to work at anything much below 7,000 MW a year, the industry would feel the pinch.

This question of size was developed further by the Hon. H. G. Nelson, managing director of the English Electric Company Limited, in his paper "The New Horizon—Electrical Manufacture." It will be seen from the accompanying graph that the size of generating sets rose slowly but steadily from 1920 to 1950; after that the rise has been much more rapid. The largest single shaft machines at present on order in this country are of 350 MW capacity. By 1963 it is expected that cross-compound double-shaft sets of 550 MW will be commissioned, and if the post-war trend continues, there could be 1,000 MW single-shaft sets in use by 1970. By 1980, 4,000 MW sets could be expected to be the requirement.

At present it is not possible to see how single rotating machines of more than 550 to 600 MW could be made, the main limitations being the strength of the end bell and the size of load which can be transported from the maker's works to the power station. Under present conditions the load limit for road transport of a single item is about 160 to 200 tons, according to the route. There is, however, no reason to expect that the problems facing the manufacturer at present will be insoluble. One solution to the transport problem would be to make the stator on site. Developments in metallurgy and the use of some of the newer metals might well provide the answer to some of the other manufacturing problems.

They spin them out down under

This is not a reference to Aussie spin-bowlers but to the David Brown underfloor spinning machine for castings in *Taurus bronze, bringing the enormous advantages of centrifugal casting to the solution of complex metallurgical problems.

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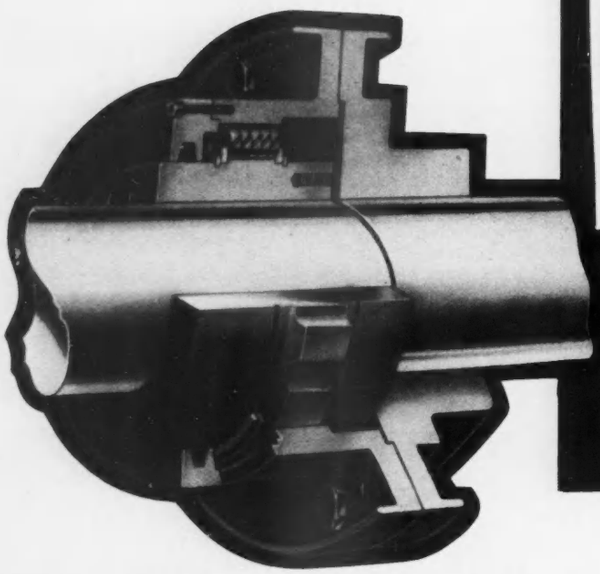

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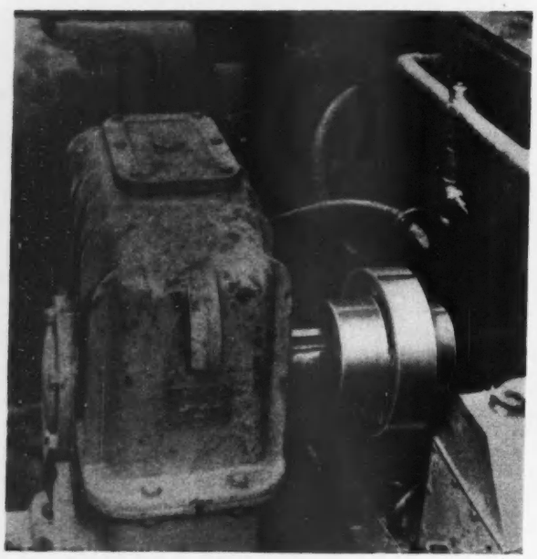

- Allows for shaft misalignment and accommodates end-float.
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Human Element

Technical Training Week Next Year

SEVEN of the ten Commonwealth countries and 18 dependant territories have so far decided to join 1961's Commonwealth Technical Training week.

The idea for the week was put forward by the Duke of Edinburgh after he had seen a State Apprenticeship week during his visit to Australia. Before the week begins (it will be held from 29 May to 4 June) it is planned to send out 45,000 copies of the campaign guide *Training Today for Tomorrow*.

Every firm employing ten or more people should receive one. Trade unions, local authorities and their educational executives and employers' organisations will all be sent a copy.

Open days at local works and colleges, careers exhibitions and religious services are among the activities suggested in Training Today.

Support for the cost of the week is coming from the British Employers' Confederation who have contributed £24,000, the Government who will seek approval for a donation of £8,000 and the nationalised industries who are giving £4,000.

There is of course a universal need throughout the Commonwealth for a greater output of technically trained people. In the United Kingdom the need is twofold. First to meet our own increasing needs and secondly to provide the technical aid looked for by the developing nations overseas.

Ten Per Cent off Air Firm's Salaries

The difficulties with which the United States aviation industry is struggling are dramatically underlined by the Douglas Aircraft Company's decision to cut all salaries by ten per cent.

The president of the company and the chairman have each accepted 25 per cent reductions. All other corporate officers are to be cut by at least a tenth.

A company statement refers to the " critical period of readjustment " and says that reasonable reductions in administrative costs and other economies should place the company in a stronger competitive position.

No one in the company, who say that some 14,500 people are affected, will be reduced below the classification for his job.

Criticism came swiftly from the aircraft workers' union which does not think the cuts are reasonable at all. It described them as a crude attempt to get workers to accept pay rates lower than those justified by the present economic position. Union-management negotiations over pay were in progress as the Douglas announcement was made. Many of the cuts were later rescinded.

The American company executive often receives a substantial bonus calculated on the profitability or otherwise of the company in the previous year. There should be a useful cushion there for some of the salaried staff.

Other major aircraft corporations announced that they did not intend to follow the Douglas line. The Chance Vought Aircraft firm signed a two-year wage contract which specified a small hourly increase.

NPL Scientist on Lecture Tour in Russia

Mr. J. J. Hill, an electrical engineer on the research staff of the National Physical Laboratory, is in the Soviet Union giving a two week lecture tour.

His lectures are " Precise Audio-frequency Power Measurements " and " The Design Aspects of Wide Range Precision Transformers."

This is not his first contact with electrical engineers from the USSR. Two years ago Mr. Hill received the Institution of Electrical Engineers' Sylvanus Thompson award for his paper on a thermo-electric wattmeter for power and audio-frequencies. Soon after the Leningrad Institute of Electromechanics offered their congratulations on the paper and asked his help on Russian papers on like subjects.

During his tour, Mr. Hill will visit the Leningrad and Moscow Institutes of Electromechanics, the Polytechnics Institute and the Institute of Automation and Remote Control.

Urban England in Time of Crisis

In a time when the distance a family lives from the city is a social yardstick, and when there is something of a cachet about driving to and from work, the powerful pull of status seeking is directly against the achievement of an orderly, sensible life.

Hampstead Garden Suburb, Bourneville, Wythenshaw, Dagenham, swallowed or being swallowed by the urban sprawl are monuments to a way of planning overtaken by the double act of the motor car. Centrifugal in spinning houses out to the distant country lanes; centripetal in the enormous space problem created at the city centre.

But it is not necessary for England to become one great town from London to Birmingham to Liverpool, with the mountains of Scotland to the north and the Welsh hills to the west. Mr. Lionel Brett in a recent lecture to the Royal Society of Arts has set out three main headings for an inevitably complex solution.

On the first, *Transportation*, he comes down in favour of vertical desegregation. Elevated motorways certainly have a part to play, but as he points out, the example of South London's elevated railways was one of depressed land values and whole suburbs set on the path to decay before their time. Very careful handling indeed would be needed if they were to act for urban renewal of the more dreary inner suburbs and not merely spread the disease.

Three Tier Answer

Perhaps, says Mr. Brett, the outcome will be three-tier systems. The ground floor for parking and servicing, the middle for pedestrians, and fast motorways above. It would seem to be a simple improvement on this idea to move the pedestrians up into the sun on top, keeping the cars nearer their services and possibly making for a less costly top deck road.

Internal Decentralisation is the term Mr. Brett applies to the rejuvenation of suburbs like Ealing and Holloway by the judicious use of groups of sky-scrapers, bringing space (and also income) to areas which now suffer from a dead uniformity of density. Moving everything out to these local centres (except the best shops, the Government, Law, the City and perhaps the Theatre) should enhance the local land values, give a new interest to life in the area and materially ease the traffic problem at the centre.

Instead of one vast pyramid the replacement would create a whole series of ranges of peaks.

The last of Mr. Brett's three—*Migration*. Straight off the map he mentions Hereford, Louth and Dumfries as towns that could have happily expanded to take another half million people and their employment. Accepting that such development may not be economically feasible he looks further afield to older industrial centres such as South Wales and Tees-side as places well sited for growth.

It is reasonable to observe that recent movement seems to have been largely against Mr. Brett's undoubtedly beneficial view. The bulk of the motor industry's expansion has gone to the Liverpool area and the Scottish lowlands. South Wales has received relatively little and Tees-side less.

SPUR, the Society for the Promotion of Urban Renewal, is now every bit as important as the Council for the Preservation of Rural England. One job cannot be done without the other. If they do not succeed our unfortunate successors are one day going to be joining the Society for the Renewal of All England.

The Usual Fun and ETU Games

Down at the sunny seaside on the south coast the delegates at the annual conference of the Electrical Trades Union have been enjoying their usual occupations. These include heartfelt applause of the General President, Mr. Frank Foulkes, especially for his annual verbal assault on the Press.

If the proceedings this year suffered the indignity of having police called to what might be called a " fringe activity " it should not be thought that serious and important statements relevant to the next 12 months in the electricity supply industry were left unsaid.

Not surprisingly delegates were in favour of the Boilermakers' proposal for a one day strike in favour of higher old age pensions. On the face of it this is precisely the sort of demonstration which any government should ignore.

The references to the unofficial attempts to cause a stoppage in the power stations earlier this year were to say the least—confusing. Some voices made the familiar observations that such unofficial leadership was deplorable. Some intransigents went on from there to assert that the deplorable part was failure to bring about a strike.

That a majority of the men employed at the power stations were more or less satisfied with things as they are brought derisive comments from at least one delegate.

Had action in the courts not been pending, the conference would have heard some interesting reflections from Mr. Foulkes on the current situation in battle of allegation and denigration brought on by supposed ballot irregularities and suppression of members' rights. The General President declared that he had to omit a considerable portion of his speech.

What Hastings missed last week may be heard in the High Court before the autumn.

The Treasury Still in the 19th Century?

Has the Treasury not noticed the existence of the science of personnel management?

Whether personnel management is a science or not the Treasury is the key to the conditions and fulfillment or otherwise of the Civil Service. Major reforms in Treasury methods are now needed, according to Mr. T. Lillywhite, the leader of the Civil Service Clerical Association.

Addressing the union's annual conference at Douglas, Isle of Man, Mr. Lillywhite accused the Treasury of having a negative employment policy and of deliberately using delay as a way of avoiding change.

The members of the Civil Service Pay Research Unit may have been justifiably surprised at one delegate's contribution to the debate. Seconding a resolution supporting the executive's policy of linking pay claims with comparisons with outside industry by a pay research unit, the delegate made a curious qualification.

The pay research unit was " all right " he thought, so long as its work was honest. The unit may have heard echoes of some doubts about the lack of speed in its efforts. No one can seriously doubt the absolute integrity of those engaged in the work.

Railway Air Expert leads Transport Institute

The President of the Institute of Transport, 1960-61, is to be Mr. K. W. C. Grand, a member of the British Transport Commission whose experience embraces railways, the introduction of air services, bus companies, ship repairing and the Railway Clearing House.

Mr. Grand attained his diversity of transport experience at a variety of levels. He joined the Great Western Railway at Park Royal goods station in 1919. Through a number of posts he moved up to become a divisional superintendent in 1936 and principal assistant to the general manager of the GWR in 1939.

During the Second World War Mr. Grand served as liaison officer to the Home Guard, with the rank of Colonel.

On nationalisation he became chief regional officer of the Western Region of British Railways.

The air experience came from the introduction of the railway-operated air service between Cardiff and Plymouth in 1933 and the development of similar services. Among the air companies of which he has been chairman are Channel Islands Airways and Olley Air Service.

Chairman of the Railway Clearing House 1953-55, in its last days as a statutory body, Mr. Grand is now chairman of the Transport Commission's clearing house committee.

Arouse New Interest with an Open Day

There is nothing quite like an open day for stimulating fresh interest in the work of an organisation. It is good for staff morale as well as for developing personal contacts with customers and clients.

By Miss I. M. Slade

British Iron and Steel Research Association

AN OPEN DAY is quite a complicated affair. It includes an exhibition, but is at the same time a social occasion, and has some of the characteristics of a conference and of an advertising campaign. This combination, acting together, can have more effect than any one of the constituents acting separately.

In addition an open day has certain characteristics of its own. It is an occasion when people not usually in the public eye have an opportunity of showing what they do, and it is one of the very few occasions when work is shown in its early stages, before it would be displayed or discussed at any of the other functions mentioned.

If open days are so effective why are they not even more frequently held? This is because they have some quite serious drawbacks. They cost a great deal of time and money and they disrupt the work of the organisation holding them for quite long periods.

There are disadvantages as well as advantages in showing things half done. Sometimes, too, people not used to speaking in public are not good advertisements of their organisation when they do it, and it is possible to display ignorance as well as knowledge. Experience shows, however, that most of these dangers can be avoided by proper preparation and that the main disadvantage of an open day is the time needed for preparation and the interference with normal activities.

Organisations which hold open days are quite varied. Educational institutions hold them to show the work of their students and to interest others in it. Their visitors are usually parents and relatives of students, sponsors of special studies, educationalists and those generally interested. Research establishments hold them to show what problems they are investigating and to show the results of research to the users and potential users of new developments, to other research workers, and to those who support the work financially. Commercial concerns invite their customers, competitors, and suppliers to see their plant, processes, and products.

This variety of organisations and of relationships between them and their visitors supports the idea that open days have many functions and are a flexible means of communication.

Nearly all open days include an exhibition. What are the particular advantages of an exhibition over other means of presenting technical nformation, and what special advantages has an open day exhibition over other kinds?

The main advantage of an exhibition over written and verbal communication is that it presents information vividly—visually and sometimes by touch and movement also, as when visitors can handle a product or operate equipment.

THE REAL THING

An open day has several advantages over more formal exhibitions. In the first place, at an open day, the " real thing " can often be shown in its normal surroundings. (If the surroundings and equipment have been cleaned up for the visitors, everyone gains). It is much more convincing to see the apparatus used for study or research, or the machine on which certain things are made, rather than a picture or model, especially if it is possible to see the equipment working. This is seldom possible in an exhibition hall—or only at great expense.

People are often heard to say that it is much better to make an individual visit rather than walk round in a party on an open day. It is true that a private visit may be the best way to learn in detail about one particular item, but that is seldom the aim of a visitor to an open day. If it is, then he has probably come at the wrong time, since an open day is specially suited for giving a general overall view.

There are other reasons why a private visit may not be so useful, quite apart from the fact that, if all the people who came on an open day asked for individual visits, it would bring the work of any organisation to a standstill. Modern equipment is often so complex, or so enclosed, that it is not possible to see what is going on when it is operating. At an open day, however, seeing the equipment, and often its operation, is usually combined with normal exhibition techniques of explanation. When a process is invisible, a diagram with a short description is supplied and, for those who want a more detailed idea of what happens, a longer written description is often provided. In addition, the expert in charge of the particular item is usually there to be questioned, argued with, and criticised.

DIRECTNESS

It is this combination of means of communication that gives an open day a reality, directness, and completeness often lacking from more formal exhibitions, where, even when the real thing can be shown, it is out of its normal setting and the person manning the exhibit is seldom the one whose work it is.

An expert, especially one responsible for a new development, can sometimes be questioned and criticised at a conference but, even if he presents a paper and so invites such questioning, he seldom has his equipment at hand to demonstrate how he uses it, nor can he invite the questioner to " see for himself " when a doubtful or difficult point is raised, as he can on an open day. Moreover, the things discussed at open days are often of a kind that are not presented at conferences—students work for example—and research workers seldom present papers on their work while they are still trying to solve some problem relating to it. A commercial company does not advertise some new process while still trying to make it economic, or a new product until it has succeeded in producing one of satisfactory quality.

At an open day, however, work in progress is usually a large part of the display and often the part that excites most interest. It brings the opportunity for discussion and criticism—so valuable in producing new ideas and new ways of looking at things—to bear on work in progress. The visitors gain new ideas and also give them. The research worker or student who normally only discusses his work with his colleagues and supervisors has to explain and defend his ideas to all comers. He is not, however, expected to have all the answers. He can describe what he is trying to do and show his failures as interesting exhibits. Visitors will often try to explain them and suggest ways of avoiding them.

This discussion, explanation, answering questions, and meeting criticism of ideas while they are still in the formative stage is something the organisation holding an open day gains, but which is seldom taken into ccount.

Another advantage to the host organisation, which may be important, is that during an open day everyone or nearly everyone in it is on show —not just the heads of departments, but all the junior staff who never get a look-in at technical conferences, and who would never presume to write a paper for the scientific journals on what they are doing. They can all, down to the humblest machine operator and laboratory assistant, demonstrate their skill to the important people who come round. It is very good for their future progress and excellent for morale.

An aim of an open day is to show how much the organisation holding it is doing. It is held for and gives publicity of a sort that is not easily obtained in other ways. Brochures are apt to be unread, or only very sketchily taken in, even when (as they so often are) they are beautifully produced and illustrated.

Friends of students of a college or school, members of a research association, customers of an industrial company, seldom realise the range of activities, processes, or products, with anything like the same force as when they see them *in situ*. Visitors frequently comment with surprise on the number of things being done in spite of having been notified regularly about them. Reports have not made an impression in years. Seeing what is happening has done so in minutes.

The much greater effect of showing things to people rather than writing about them is so noticeable that it is probably the most important aspect of an open day—direct personal contact between the staff of the host organisation and the visitors.

Experience continually strengthens the conviction that personal contacts are the most important way by which technical information is transmitted. In scientific knowledge things seem to have come full circle—originally scientists knew each other and told each other about their work. Then with the spread of knowledge they could not all meet or correspond, so they wrote papers describing their work, and these were printed in scientific journals that other scientists read and used to keep themselves up to date. Now the amount of reading matter has become too great for anyone to keep up-to-date on more than a narrow range of subjects, and this has produced the present age of specialists. Those who want technical knowledge on a broad front despair of keeping up-to-date by reading, and are going back to personal contact with the various specialists who keep themselves up-to-date by reading in their own subjects. Open days are an effective way of providing it. They also strengthen other links such as those between a research association and its member companies, between the staff of a school or college and the parents and friends of its pupils, or between a company and its customers.

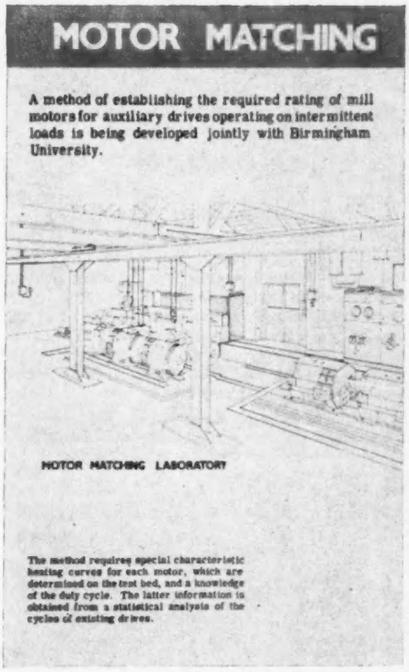
Also, although this may not be important for all types of organisations, open days give an opportunity of returning hospitality. This is particularly useful to an organisation such as a research association whose staff receive much hospitality and have few chances of returning it.

SELECTING EXHIBITS

The first problem in arranging an exhibition is to decide what to exhibit. As already indicated there are so many things going on in most organisations that it is impossible to show all of them, even if the staff organising the display could cope with so much.

It is of course usually undesirable to show everything—even if none of it is confidential. Too much may confuse or produce less impression than if fewer things are shown. Hence one should choose items for display that are likely to be of most interest to the visitors and those that the exhibitors most wish to show.

The choice is not always easy as things of importance do not always lend themselves easily to display, and often nearly everyone is convinced that his particular item is so important that the exhibition will have no point if it is


MOTOR MATCHING
A method of establishing the required rating of mill motors for auxiliary drives operating on intermittent loads is being developed jointly with Birmingham University.
MOTOR MATCHING LABORATORY
The method requires special characteristic heating curves for each motor, which are determined on the test bed, and a knowledge of the duty cycle. The latter information is obtained from a statistical analysis of the cycles of existing drives.

" How difficult it is to explain some scientific research . . . within the limits of a display board." When it is impossible to explain, copies of a fuller description are made available.

omitted. It may have to be a policy decision taken at the top, but it is most important that no one should be kept unfairly in the background, and the organisers need to have a fairly free hand in putting in additional items, in the interest of general happiness and good morale, even if the top management think these items are unimportant.

A method sometimes used to deal with the difficulty of showing enough of each section to satisfy the specialist visitors without over-loading the person who comes to get a general idea of what goes on in the whole establishment, is to indicate certain items for those who want a general tour, and to suggest that they omit others displayed for the specialists.

The specialists' items are best displayed slightly off the main route, provided they are not pushed into an inaccessible spot where they can easily be missed by those who wish to see them.

When the exhibits have been selected the next problem is how to display them. Can equipment be shown in operation and, if so, what additional information needs to be given? If work is related to something not exhibited, then what background material, models, flow diagrams, sections, etc., are needed to make its purpose clear? If equipment is enclosed, how and at what points should one add explanatory displays?

In general the problems are those of any exhibition manager but, as indicated, there is more scope and more variety than in other types of exhibition. As always, visual displays are needed that will make the casual visitor stop and look more closely. When he has stopped one has to make sure the exhibit is clearly explained.

ONE IDEA

A display board caption is rather like a newspaper headline: it has to get one idea across, but the remaining text has to be very much shorter than the journalist's item. It should contain not more than 50 words and preferably much fewer. Much explanation can be omitted by using suitable photographs, diagrams, charts, etc., and this makes a more interesting and arresting display than one with too much written explanation. Even so, anyone who has not tried to do it will be surprised to find how difficult it is to explain some scientific research or new process, instrument, or product, within the limits of a display board, without covering it with writing and making it dull or troublesome to read.

The fewer words one has to use, the clearer one's ideas have to be. Nothing shows up muddled thinking more quickly than an attempt to draft a descriptive caption. In the writer's organisation the man whose work it is intended to exhibit is first asked to describe what he is doing in the fewest possible words. He usually produces a sort of essay on his work, from 300 to 500 words long. In the worst and least tractable cases he refers to his last report, but he will usually do better than that.

The organisers read this essay—or report, if they are driven to it—and note whether he has said why he is doing whatever it is (this is frequently omitted) and whether any steps seem to be missing. They must put themselves in the position of someone who has never before heard of it and judge whether they could understand what he says. Sometimes they are nearly in this position but often they know something about it, and this saves time, even though it may not produce a better final result. Then, if necessary after going back to the exhibitor for the missing bits, the description is rewritten. If it is still too long an attempt is made to shorten it by using diagrams or photographs.

When the organisers have done their best they send it back to the originator, asking if he agrees with what is said. This check is most important and must be made even if the text has to go backward and forward a good many times before an agreed version is obtained within acceptable lengths. The temptation to cut or alter without checking is often very great but, if given in to, almost invariably leads to disaster as well as to a great deal of ill-feeling, since a superficial understanding of a difficult concept (which is as much as an exhibition organiser can expect to have of most items he displays) leads to distortion, even if the true " howler," that will make the experts smile, is avoided.

The whole process is very hard work and takes a great deal of time, patience, and hard thinking, and a good deal of give and take on both sides. Much the same process is used for the longer descriptive " handouts," which are, however, easier to write because there is less limitation on length.

FORCED TO THINK

Is all this work on descriptive captions and handouts worth while? There is good evidence that visitors greatly appreciate simple and clear descriptions but, if that were the only result, the work put into each display board might not be justified. It has, however, some valuable by-products. The visitors may or may not fully understand what the exhibitor is doing or why, but the exhibitor has been forced to think about these things very carefully indeed, and both he and the organisers who discuss the wording with him have learned a great deal in the process.

If anyone thinks this is nonsense and that supervisors and research workers must know what they are doing and why, then it is certain he has never tried to make them set it down in the fewest possible words. Philosophers are not the only people who confuse and deceive themselves in a maze of words.

Also, this preliminary argument and cross-questioning gives those who will be manning the exhibits good practice for dealing with visitors' questions. The large amount learned by the organisers during the preparation of the material is often of lasting value to them in their other activities. It is impossible to prepare an open day display properly, without gaining a comprehensive general knowledge of the work that is being displayed and it is a most valuable experience for information or publicity staff.

After the wording of the display has been agreed the next stage is to discuss the material with the designer. The organisers present their suggestions and he considers them and makes his own. This leads to more discussion and to various arrangements being tried. A good design can make all the difference to the display. It is the designer who stops people in the first instance and makes them look at what has been written. Then the tracers, draughtsmen and photographers have their turn, all of whose work has a great effect on the final result. Others are more competent to discuss the problems and methods of the display designer. It is for this reason that no more is said here of a most important step which can greatly add to or detract from the results of all the work.

The writer has been fortunate in dealing with a design and drawing office that always makes the best of the material given them and an example of their work is shown in the illustration.

SNAGS

Finally, what are the chief snags in organising open days? The greatest is that no one ever believes it will take as long as it does, and hence no open day begins to be organised in time. This puts an unnecessarily heavy load on the organisers, designers and draughtsmen. An inexperienced organiser should allow twice as long as he thinks he needs.

Among the staff who take part in open days, some enjoy them and appreciate the opportunity of showing their work, and others hate them. It is worth while trying to convince these last that open days are worth while, however much they as individuals may dislike them, because it is impossible for the organisers to make the occasion a success without the full cooperation of all who take part. The organisers must depend on others not only for the technical accuracy of the information they put across but still more on all welcoming the visitors and describing their work enthusiastically, clearly, and patiently.

However, willing those who man the exhibits may be, it is most important that they should be well briefed to answer inquiries adequately without either launching into a lecture or merely remarking something like " It measures the activity of binary systems," or " the points lie on a hyperbolic paraboloid," leaving 99 per cent of inquirers no wiser than before.

How often should an establishment hold open days? In a research establishment, if one is to show real progress, once in three years is probably the minimum gap that allows a predominantly new display to be put on. On the other hand, if one wants to keep continuity of interest, visits should be encouraged at not too long intervals and five years is as long as is wise. Many organisations hold open days annually and, in a college or school where the change of students is rapid, this is probably the best interval. With industrial firms, open days are usually very occasional happenings, and that is again probably the right thing to do where the interruption to production is a serious loss, and the introduction of new products or processes is infrequent.

In addition to the information side of open days one has to try to anticipate what visitors will need. This includes the obvious things such as food and drink, cloakrooms and washrooms, rest rooms and chairs to sit on in as many places as possible. Chairs are most important, as nothing is more tiring than an exhibition. Guides and messengers, railway timetables, and someone to ring up for taxis, a manned first-aid room in case someone falls down the stairs, parking facilities, the names of the nearest garages for emergency repairs, and so on, are essential.

However careful one is, there are always a few mistakes of fact in the displays and the expert is always there to point these out; one has to accept that. There is always the visitor who loses his way and blames the organisers, however careful they have been to provide maps and charts, and there is the visitor who wants something one has not thought of. These, however, are the exceptions. The good will and pleasure shown by most visitors make all the hard work worth-while and provide the best possible atmosphere for making contacts that can later be developed to the benefit of hosts and visitors.

Jarrah and Karri: Two Heavy Duty Timbers

Jarrah and karri can both be obtained in large sizes. Jarrah is especially well suited for sea works and karri for superstructures clear of the ground and water.

By D. J. W. Dalby, M.B.E., A.R.I.C.S.
Engineering Consultant, W. W. Howard Bros and Company Limited

THE design of any engineering structure is initially a problem of choosing the material best suited to fulfil the requirements demanded by the engineer, especially with regard to endurance and low maintenance costs. The object of this article is to present some mechanical properties of two not so well known timbers: they are the two Australian eucalypti, jarrah and karri, both of which are now available in the United Kingdom after years of restriction

Jarrah

Jarrah (*eucalyptus marginata*) is the principal timber of the State of Western Australia. Because of its resemblance to a Honduras timber it was originally called mahogany; however, about 1860 it was realised that the timber had so many fine qualities of its own, that it was henceforth called by its aboriginal name of jarrah. The tree attains a height of 100 to 130 ft with an average diameter of 6 ft and is to be found through the western coastal areas.

The timber is dense and hard, but fairly easily worked, and weighs about 56 lb per cu. ft. It is a red colour, darkening with age to a rich brown, with a beautiful grain. There are few uses to which jarrah cannot be put when, in addition to beauty of colour and grain, account is taken of its strength, durability and very high resistance to fire.

Its uses are many and varied, and form the solution for all timber problems in Western Australia. In fact, it has been employed to such an extent that there is scarcely a pier or jetty in the state which does not contain a high proportion of jarrah. It is known as one of the world's most fire-resisting timbers, and as such has the approval of the London County Council. The durability of the timber is remarkable as it is practically immune to marine borer attacks and is highly resistant to decay, for which reasons it is widely used for piles of wharves and jetties.

The superiority of Jarrah for sea defence work is strikingly illustrated in the photograph which shows the damage done to concrete sea walls at Sheerness, Kent, by heavy seas whipped up by the strong gales which raged along the south-east coast in 1938. In contrast to the sorry state of the concrete structure, which was smashed to pieces, is the undamaged state of the jarrah breastwork.

Great care must be exercised in the kiln seasoning of jarrah to avoid warping, and partial air-drying before kiln drying is recommended. In the kiln drying of green material to 15 per cent moisture content shrinkage can be expected as follows:

tangential .. .. 1 in per ft, or 8 per cent
radial .. .. $\frac{1}{8}$ in per ft, or 5 per cent

Moisture content in 90 per cent humidity will cause approximately a movement of 21·5 per cent and in 60 per cent humidity about 14 per cent.

Karri

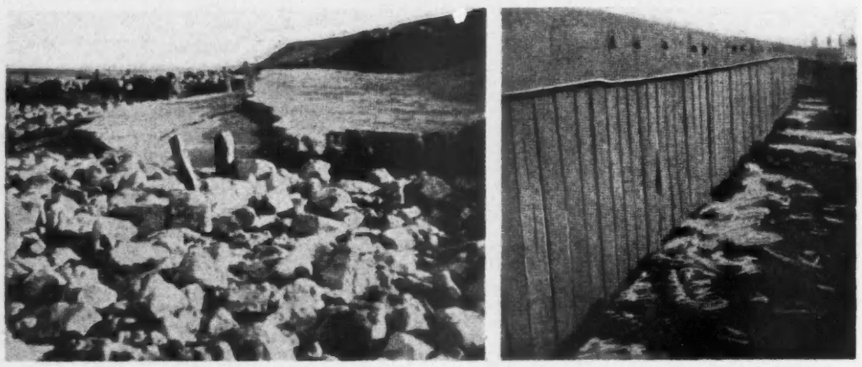
Karri (*eucalyptus diversicolor*) is the aboriginal name for "that noble tree," and the prime stands of karri forests constitute some of the most magnificent hardwood in the world. Trees up to 286 ft with a 24 ft girth have been measured. The prime forests extend over an area of approximately 500,000 acres, practically the whole of which has been designated as State forest.

The timber is reddish brown, closely resembling jarrah in appearance, though perhaps lighter in colour; in most cases, however, ordinary methods of inspection fail to distinguish between the two, and the only simple method is by burning a splinter of the woods, the ash from jarrah being black and that from karri, white. It should be noted, however, that this test should only be applied to sound hardwood exposed to weathering. But as the milling of jarrah and karri in Western Australia are so separated there is little chance of any mixing taking place prior to shipment.

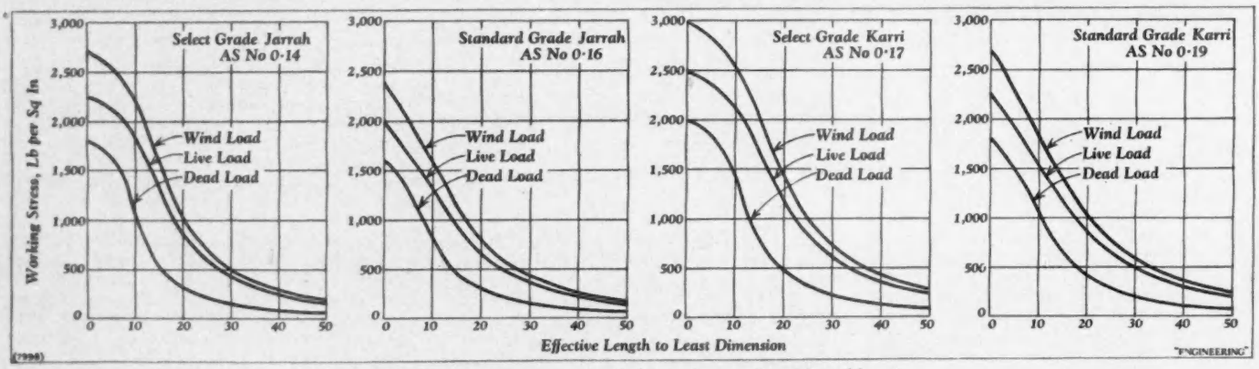
Karri is moderately heavy, having a green density of 72 lb per cu. ft, and a dry density of 58 lb per cu. ft. It is stronger than jarrah. It is not, however, as durable in the ground or under water as jarrah and it is not generally recommended for uses in conditions that are damp unless it has been subjected to preservative treatment. On the other hand, it has now been recognised that under all conditions out of contact with the ground and in properly ventilated buildings, karri gives long and efficient service, so that it is favoured for uses where its high strength properties give it an advantage.

The uses of karri are numerous. The strength and stiffness of the timber, together with the extraordinarily long, clean lengths which may be obtained, render it unsurpassed for superstructural work, and in fact has in recent times been tagged "the queen of structural timbers" and "Karri, the beam timber." It is possible to obtain karri in larger sections and longer lengths than any other known hardwood and one very illustrating example is that in one of the mills in the karri forest, the roof is carried by two trusses with a common tie beam consisting of a 12 in by 12 in karri 80 ft in length. In some of the deepest mines of the world, including those of South Africa, Germany, the United Kingdom and Australia, karri is playing a pre-eminent role. In all of these countries, the mine lift guides are fashioned from karri because of its great structural strength and superior quality.

Karri can be kiln dried to a high grade product producing an excellent floor which will take a high polish and produce a surface highly resistant to indentations and to wear. Suitable drying schedules have been developed and these are available if required. In the kiln drying of



The remains of the concrete sea wall at Sheerness, Kent, after a gale in 1938 and (right) the adjoining defences built of jarrah, which suffered no damage.



Permissible working stresses in timber columns of jarrah and karri.

TABLE I.—*Comparative Mechanical and Physical Properties of Jarrah, Karri, English Oak, Pitch Pine and Douglas Fir*

	Jarrah (Eucalyptus Marginata)		Karri (Eucalyptus Diversicolor)		English Oak (Quercus Pedunculata)		Pitch Pine (Pinus Palustris)		Douglas Fir (Pseudotsuga Taxifolia)	
Moisture content .. per cent	60	12	64	12	89	12	75	12	61	12
Weight per cubic foot .. lb	65	54	68	57	64	43	60	38	46	30
Static Bending, Centre Loading										
Equivalent fibre stress at maximum load .. .. lb per sq. in	9,400	15,500	11,300	20,600	8,100	13,300	7,800	13,400	7,200	12,000
Apparent modulus of elasticity 1,000 lb per sq. in	1,410	1,820	2,320	2,970	1,290	1,560	1,470	1,850	1,320	1,640
Total work in-lb per sq. in	11·2	22·4	24·8	39·6	20·4	19·1	27·6	18·7	23·9	21·3
Compression Parallel to Grain										
Maximum compressive strength lb per sq. in	4,970	8,600	5,850	10,510	3,850	7,210	3,740	7,530	3,340	6,590
Hardness										
Resistance to indentation										
On side grain .. .. lb	1,280	1,870	1,470	1,890	1,050	1,230	490	750	500	760
On end grain .. .. lb	1,370	1,990	1,460	2,080	1,120	1,460	460	810	620	1,000
Shear Parallel to Grain										
Maximum shearing strength lb per sq. in	1,300	1,990	1,320	2,270	1,170	1,760	910	1,390	890	1,390
Resistance to splitting										
In radial plane lb per in width	350	420	380	500	390	360	200	270	210	220
In tangential plane lb per in width	390	440	530	730	470	500			250	260

green material to 15 per cent moisture content, the shrinkage to be expected is.—

tangential .. 1 in per ft, or 10 per cent
radial .. About $\frac{5}{8}$ in per ft, or 5 per cent.

PERMISSIBLE WORKING STRESSES

The figures shown in Table I were obtained from tests carried out by the Forest Products Division of the Commonwealth Scientific and Industrial Research Organisation of Australia, and contain the latest information available.

TABLE II.—*Permissible Stresses in Green Jarrah and Green Karri, all lb per sq. in*

	Jarrah		Karri	
	Select	Standard	Select	Standard
Bending	2,100	1,600	2,200	2,200
Modulus of elasticity	1,500,000	1,500,000	2,300,000	2,300,000
Shear:				
Beams	190	150	200	160
Joint details ..	280	220	300	240
Bearing perpendicular to grain	600	600	700	700
Bearing parallel to grain ..	1,800	1,600	2,000	1,800

Jarrah, without any form of preservative treatment, is naturally durable, whereas Douglas fir requires expensive preservative treatment to give any semblance of durability where moisture is apparent and any break in the treated surface leads to quick deterioration.

The working stresses shown in Table II are for green jarrah and karri used in interior locations or in completely protected structures not subject to dampness or high humidity.

The permissible stresses for columns are given in the graphs and are based on formulae given in the *Handbook of Structural Timber Design* by I. Langlands and A. J. Thomas.

The working stresses given in Table II and the graphs should be multiplied by an appropriate factor dependent on its condition of use. These conditions are given below together with Table III showing appropriate factors:—

A. Completely protected from weather, with no decay hazard as described above.
B. Exposed to weather or occasionally wet, i.e. conditions embracing the use of the greater proportion of heavy structural timber, such as bridges, trestles and exposed framework.
C. Severe decay hazards or unusually wet conditions, such as contact with the ground or in wharf construction and exposed to wave and tidal waters.

The permissible stresses may be multiplied by a factor of 1·25 when the timber is thoroughly dry (less than 15 per cent moisture content).

The stresses given in Table II are for long-continued loads. For combinations of live and dead loads the values (except the modulus of elasticity) may be increased in the ratio of

$$\frac{L \times D}{0{\cdot}8\,(L \times D)}$$

where L is the live load and D is the dead load.

Furthermore, when designing for wind loads, in addition to dead and live loads, the values should be multiplied by 1·50, providing the resulting size is not less than that required to carry dead and live loads only. No allowances for impact need be made unless the impact load stress exceeds the live load stress.

Timber beams tend to sag under dead loads and to allow for this it is recommended that the dead load, but not the live load, should be multiplied by three when calculating the average deflection; i.e. deflection is proportional to L × 3D.

CONCLUSION

It will be seen from the foregoing facts that there is every reason to believe that jarrah and karri when applied in their recommended uses have no equal, especially when dealing with marine structures. The combined strength and durability of these sister timbers are so vastly superior to softwoods in this field that the latter need not even be considered. Recent observations of structures incorporating jarrah and karri up to 60 years old have proved their durability and they are, it may be claimed, more than a match for many reinforced concrete members.

TABLE III.—*Condition Factors for Jarrah and Karri*

	Jarrah			Karri		
	A	B	C	A	B	C
Bending	1·00	0·95	0·90	1·00	0·85	0·70
Modulus of elasticity	1·00	1·00	1·00	1·00	1·00	1·00
Shear	1·00	0·95	0·90	1·00	0·85	0·70
Bearing parallel and perpendicular to grain	1·00	0·85	0·70	1·00	0·75	0·50
Columns ..	1·00	0·95	0·90	1·00	0·85	0·70

Structural Details in Associated-Rediffusion's Studio 5

Associated-Rediffusion's new Studio 5 is the largest television studio in the world. It is 140 ft long by 100 ft wide and has a clear height of 40 ft. The production area is 14,000 sq. ft.

The whole building can be divided into two parts by an acoustic "door" which can be lowered in one piece from the roof to give two studios, each having a floor space of 6,700 sq. ft and independent control rooms. The door, when lowered, provides an acoustic separation of nearly 70 dB over a range of 50 to 4,500 c/s.

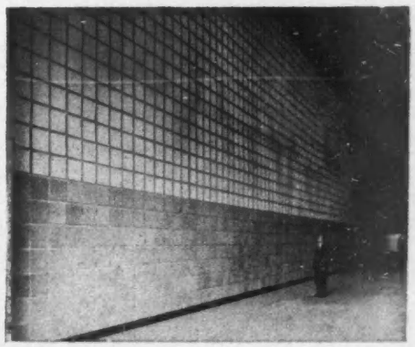
The door consists of two panels, about 6 ft apart and each weighing 25 tons, carried on a lattice framework. Each panel comprises two sheets of mild steel with 3 in of rock wool infilling. The outer sheet is hung "free" from the girder, being fixed to the girder only at the edges, and on the studio face it is covered with hardboard perforated tiles which reduce the reverberation period within the studios to a suitably low figure. To make the noise seal at the periphery, the door panels step back about $\frac{1}{2}$ in to bed-down against the slides when the door has reached the bottom of its travel. Araldhite was used to glue the steel plates to the framework. The door was designed, built and installed by George W. King of Stevenage, Hertfordshire.

The building itself is steel framed, with 13½ in cavity brick walls to cut out noise. In the 15 ft high roof space above the main 100 ft span N-girders there are walkways serving the lighting grids which are suspended 40 ft above the floor; altogether there are 680 lights slung in groups.

Especial attention has been paid to keeping the working temperature on the floor down to a reasonable level. Huge ventilating ducts run through the upper heights of the roof space, with long adjustable nozzle drops pushing fresh air down to the studio floor. About seven complete changes of air are provided every hour. In the adjacent control rooms an even higher rate of air change is used and, in addition, the air is filtered to protect the delicate equipment.

To permit the smooth movement of the eight trolley mounted cameras, the floor has been laid level to within $\frac{1}{4}$ in and at no point does it have a slope of more than 1 in 1,000. The maximum expected floor expansion is $\frac{3}{4}$ in and a construction joint has been provided across the middle of the floor. Steel comb joints have been installed so that camera jar will be a minimum when passing over the joints. The structural depth of the floor is a heavily reinforced concrete slab in which the water content was kept below 0·4 to avoid shrinkage; mechanical consolidation was also used. The concrete is topped off with a mastic asphalt screed and covered with linoleum. The main contractors have been Bovis Limited.

The control rooms, which are large enough to carry any extra apparatus required for colour transmission, are built along one side of the studio, with the vision, sound and lighting control rooms at the 12 ft level and the camera control rooms make-up and service rooms at ground level. Each vision control room—one for each half of the studio—has 14 picture monitors that will allow the selection, fading and mixing of ten sources in addition to the transmission, off-air and two preview monitors. Sound and lighting control are also duplicated. The contractors for the electrical installation were the Strand Electric and Engineering Company Limited. The basic design of the studio was controlled by Central Rediffusion Services, the television company's associated engineering group.



A "separation" of 70 bB is obtained with the acoustic lifting door across the studio.

Car Electrics Meet Increasing Loads

Greater use of electricity and severe working conditions have led to the uprating of many car components. Alternators, transistors, and surface-discharge plugs are among new devices available to meet the demand.

THE use of electricity in cars has increased steadily over recent years. Major causes include the rising wattage of headlamps, the provision of additional signal lamps (twin-tail, number-plate, dash-board, etc.), use of larger and more powerful windscreen wipers, and the increased installation of radios, car heaters, and defrosters. In addition to presenting increased electrical loads, cars are travelling slower and faster than before due to jammed-up cities and fast roads between them. As the electrical system derives its power from the engine, it must now do so over a wider range of engine speeds. The more rigorous engine operating conditions and the general rise in compression ratios also demand a higher performance.

In a paper "Electrical Equipment of the Passenger Car," by E. A. Watson, a survey is given of British practice and comparisons drawn with that of the United States and the Continent. The paper was read before the Automobile Division of the Institution of Mechanical Engineers. Some of the development trends mentioned are described below.

The generating system in a car has a much wider range of conditions to contend with than is found in other types of service. Not only does the load vary greatly, but the dynamo has to be able to meet it while being driven over a large range of speeds.

The growth of electrical load in typical cars up to the present date is shown in Fig. 1. A forecast for the future is also shown, but it does not allow for special requirements such as air conditioning, radio transmitter, electromagnetic gearbox or clutch, or electric-motor operation of hydraulic or pneumatic systems for suspensions and other purposes.

A noticeable feature of the small motors used in cars for petrol pumps, windscreen motors, screen washers and seat-adjusters, is the growing use of permanent magnet fields. This arises not so much because of any direct saving in cost, but largely as a result of the more compact design possible—often very important where space is restricted. Such motors also have the advantage of greater reliability, owing to the absence of a fine-wire field winding. They do, however, point to the desirability of international agreement on which terminal of the main battery is connected to the chassis, in the normal earth-return circuit. British practice is to earth the positive pole of the battery. Continental manufacturers earth the negative pole, while in America both systems are used with a tendency towards favour of a negative earth.

GENERATING SYSTEMS

The dynamo predominates as the electrical generator used in cars. The growing range of speeds over which it has to produce a useful output is shown in Fig. 2; but this range may decrease in the future with the greater use of automatic gearboxes and overdrives.

The very large speed range over which a car dynamo works means that at the high-speed end of the range it operates with a small field flux and a very heavy armature reaction. This grossly distorts the field under the pole tip and in the interpolar gap, making commutation conditions very difficult. As a result, the commutator tends to be the hottest portion of the machine. It is, however, the portion that is least able to deal with excessive temperature rise, and the increased temperature may lead to softening and throwing of the solder on the armature connections and the conduction of heat to the adjacent bearing. Modern practice is, therefore, to use an open-ventilated construction, with a powerful extractor fan combined with the drive-belt pulley, and large apertures at both ends of the dynamo. Openings at the commutator end are sometimes formed so as to direct the cold air on to the commutator surface. By proportioning the field coils so as to leave adequate passages for air to flow through the body of the dynamo, a great increase in the permissible rating of the machine for a given temperature rise has been possible. The results are shown in Fig 3.

Rapid progress in rectifying devices, particularly the production of the silicon diode, has led to the serious consideration of a.c. generation in place of the usual dynamo. Using a three-phase construction, an alternator offers a specific weight and volume better than the conventional dynamo. However, this is offset by the increased cost entailed in internally winding a small stator as opposed to externally winding an armature core. The relative cost of six rectifiers compared with that of one commutator and brush set also enters the picture. It looks, therefore, as though

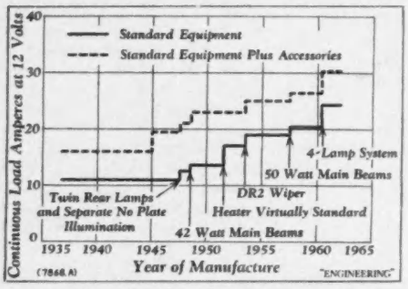


Fig. 1 The electrical load of passenger cars have increased steadily over recent years and shows every prospect of increasing further still.

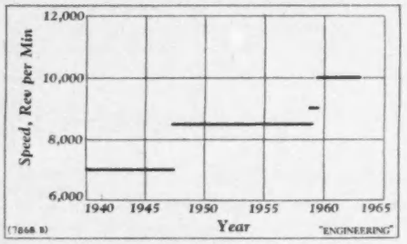


Fig. 2 As road speeds have increased, so have dynamo speeds. The graph shows maximum operating speeds for Lucas car dynamos.

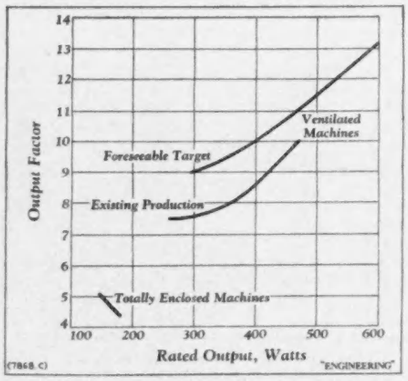


Fig. 3 Redesign of dynamos has resulted in increased specific output through improved cooling. (Output factor = watts/(weight × speed) where weight is in lb and speed in 1,000 r.p.m.)

the present type of d.c. machine will hold its own for some time to come.

Regulation of the dynamo output to hold it nearly constant as speed changes is generally carried out by periodically opening the field circuit (generally with the insertion of a resistance across the contact points). As speed increases, the length of time the field is broken per cycle also increases, reducing the excitation and so keeping the output constant. The double-contact regulator, which uses the same principle but also has a second stage in each cycle when the field is short circuited on itself, is widely used on the Continent, but not in the United Kingdom or the United States. The advantage is that a higher resistance can be put across the points, and this enables higher field currents to be handled. Complexity of the unit and the difficulty of adjustment are the disadvantages.

The satisfactory functioning of the regulator depends on the capacity of the contact points to open the circuit many times a second throughout its life. At present this sets a limit to the current which can be handled. The transistor, however, would appear to offer the possibility of avoiding the problems associated with the contact points.

The regulator combines two functions—that of a switch breaking the field circuit and that of a standard of reference, defining the value of the voltage or current at which the field is broken. By itself, the transistor can fulfil the first function. It can be used purely as a switch responsive to a relatively small current which is itself controlled by a miniature regulator of the normal type. The current handled by the contacts is greatly reduced and the increase in cost over the normal type of regulator is small.

Alternatively the magnetic circuit and spring reference system can be dispensed with and the reference provided by a Zener diode. This system is considerably more expensive, but its use may be justified in future.

IGNITION

The ignition system of modern cars has probably achieved a greater degree of standardisation than any other part. Various non-standard devices are occasionally used to meet difficult conditions of operation. A transistorised ignition system has recently been described in ENGINEERING (15 April '60, p. 537).

To increase the proportion of time during which the contact points are closed, arrangements of twin contact breakers have been used. They are unpopular owing to the difficulty of adjusting them. Another method of attack is to use a coil with a ballast resistance that has a low value under normal conditions but heats up and limits the current during slow-speed running.

Much of the problem of selecting the sparking plug of the right heat value would be avoided if a satisfactory semiconductor or surface-discharge type of plug could be produced. Although the voltage required to initiate a discharge across an air gap in a normal plug is of the order of 10 kV, that prevailing during the major part of the discharge is only a few hundred volts. In the surface-discharge plug, initiation of the discharge takes place not by direct breakdown through the air but on the surface of the insulator.

Initial work on such plugs was done with a semiconducting "insulator" possessing a negative temperature coefficient, which would tend to concentrate the current flowing over the surface into a single channel, producing heat and subsequent ionisation. An alternative is to use an ordinary ceramic insulator which, when coated with the usual engine film of thin carbon, acts in the same way. Although an engine can be operated with such a system, there are certain problems—particularly in connection with radio interference suppression—which prevent its use in present conditions. It is available if increasing compression ratios produce difficulties in the normal system.

Triangular Pitch

CALDER Hall and Windscale have been used synonymously to describe the Atomic Energy Authority's site in Cumberland, although strictly speaking the names apply to distinct projects sharing the same site. Soon a third project and a third name will add to the confusion: the Advanced Gas-cooled Reactor complex, or simply the AGR. Located adjacent to the Calder Hall reactors and the Windscale chemical plant, the project has now reached the half-way mark and is being rushed to completion at breakneck speed. The project involves two full-scale reactors, Hero and AGR, and four subsidisary facilities.

Separate Administration

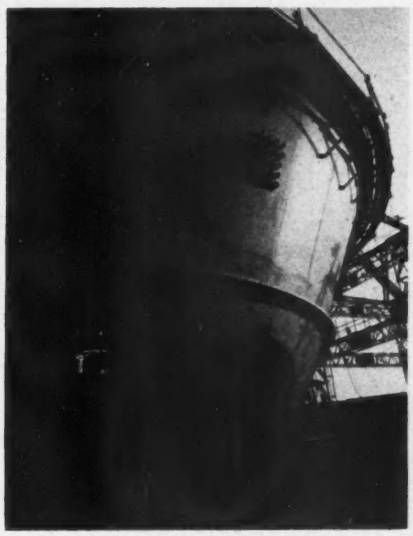
The UKAEA has great hopes for the advanced gas-cooled project. Listening to the engineers working on the site and preparing the experimental programme, one hears little of the gloom that tends to settle these days wherever businessmen talk atomic energy. Instead, there is confidence that the AGR is heading in the right direction, and that the project's timing is just right. The AGR is now well past the experimental stage and has been turned into a full development programme, independent of the operation of Calder Hall or Windscale. The AGR will have separate administration, technical personnel, laboratories, and fuel examination line, sharing only the heavy maintenance facilities and some of the services available on the site. In certain cases this " independent project " approach has been carried to extremes. For instance, although the site is linked to the national grid, and there are four reactors producing 184 MW of electricity in eight turbines not more than a quarter of a mile distant, the AGR has been equipped with a stand-by diesel-electric set, and a roomful of batteries for emergency power.

Dragon's Hot Breath on the Back

There is little doubt that the project is being rushed and that the Authority has heavily committed itself in favour of the AGR. The die was cast in February, 1959, when it was first indicated that the high-temperature reactor project Dragon would be handed over to the OEEC for further development. Up till that moment the Authority had control over both projects and could have retained Dragon had it thought this advisable. Although nobody doubts that the high-temperature gas-cooled reactor is a sound proposition capable of an engineering solution, there is a very important difference between Dragon and the AGR. In February, 1959, Dragon was an exciting concept requiring extensive experimentation to eliminate the associated question marks; while the AGR by that time was ready for the prototype stage. The Authority decided to hang on to the AGR. But with Dragon's hot breath on their back, there is only a limited time available to develop and sell the AGR concept. An accelerated programme was devised, involving the simultaneous construction of five important nuclear facilities. The five together form the advanced gas-cooled project.

Making Use of Past Experience

To speed the programme much use has to be made of extensive information accumulated with the Magnox series of reactors. The chief differences from the nuclear physics point of view between the Magnox stations and the AGR is in operating temperature and lattice pitch. Calder Hall and the civilian reactors all use square pitch (Tokai Mura excepted), but the AGR s compact core will be based on a triangular lattice arrangement. The gap has to be bridged somehow and a large exponential pile using Calder Hall graphite and fuel has been erected, in which the effect of changing the pitch on the neutron flux distribution will be measured. The square pitch experiments have now been practically completed, and the pile, erected in one corner of the adjacent Windscale pile's blower house, will be dismantled and reerected on the triangular pitch next week. The exponential pile is encased in an enormous cardboard box in an attempt to keep the dust out, while workmen only a few feet away are busy with air-hammers and blow-torches, demolishing old foundations and removing the rows of filter frames that make the place look like a disused aviary. White laboratory coats and shoe covers seem strangely out of place.



Construction of the AGR containment vessel (above) is nearly complete. When in operation, the two high-temperature reactors Hero (below right) and AGR (below left) will serve as test beds for and advanced gas-cooled reactor programme.

Hero for High Temperature

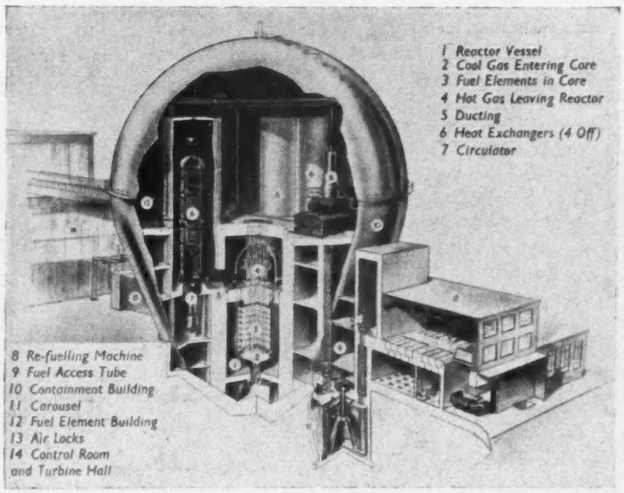
In the opposite corner of the blower house rises the massive steel and concrete structure of HERO, the high-temperature critical facility. To make room for the pile-cap, the roof of the blower house had to be knocked out and fresh concrete rises some 20 ft above roof level. The biological shield is now complete and soon sections of the stainless-steel reactor vessel will begin to arrive. Hero will be used for physics experiments at AGR temperatures, and was designed for flexibility in core arrangement and operation. The low power level will permit access to the core after the reactor has been operated. Two gas circulator loops are provided, these can be controlled independently and can be used for heating or cooling (Atomic Review, 19 Feb. '60). To measure the temperature coefficient of reactivity of the fuel, the complete core will be brought to operating temperature using both blowers. Then one blower, connected to the fuel channels, will be switched to cooling, while the other blower will keep the moderator temperature constant, and the reactivity changes will be measured. The project's accelerated pace is indicated by the fact that design information from HERO will come too late for incorporation in the AGR prototype. This seems to worry Sir William Cook not at all. Although it would have been preferable to have the reactor physics data available during the AGR design, the fact that it was not makes little difference.

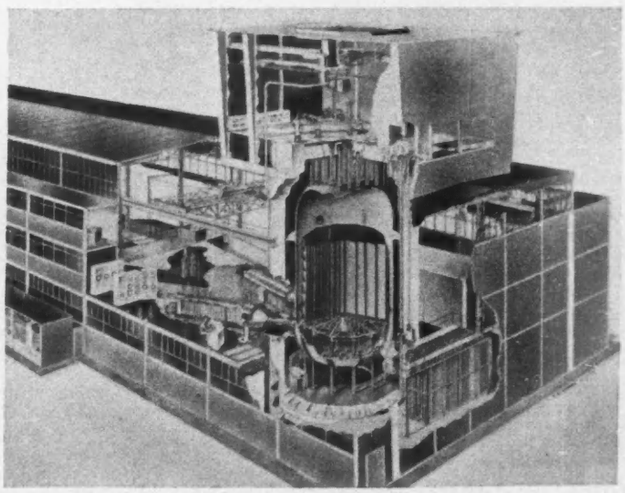
Hasten the Process of Loading

Between the exponential pile and Hero's steel skeleton sits a squat concrete box looking very much like the war-time pillboxes that ring the Windscale site, complete down to firing slits. It will contain a small exponential pile duplicating a section of the actual AGR core and will be used for fine structure measurements. The firing slits receive the neutron sources. The pile will be in operation by September, again, as with HERO, the information will be too late to affect the design of the AGR. The experiments are aimed at speeding the process of loading HERO and AGR by obtaining accurate data in advance. Control rod worths and the distribution of absorbers will also be determined using the stack. Later, in 1961, a second fine-structure stack will be erected which, instead of neutron sources in the base, will utilise a neutron beam direct from the AGR, and will aid the evaluation of the exact radiation dose received by the AGR fuel elements.

Separate Roads to Criticality

The floor is now being cleared adjacent to the fine-structure stack for a fourth facility known as the Approach to Criticality Stack. An exact replica of the AGR core in a size approaching criticality, the stack will be used to obtain advance information on fuel loading. Owing to the small AGR core size, the empirical correction factors for criticality calculations developed for Magnox reactors cannot be applied directly and a check is necessary unless the core loading is to be extremely tedious. The stack was designed for rearrangement into other pitches, so that once the commercial application of advanced





gas-cooling becomes a reality, it will be possible to check civilian reactor core designs. Thus with the exception of the large Calder Hall type exponential pile, the series of critical and subcritical experiments under construction in the blower house are clearly intended as the basis for a large civilian construction programme involving many competing or successive stations.

Duplication is Good Investment

The biggest tool in the AGR shed will of course be the 100 MW(t) prototype. It would be a mistake to regard the prototype as the culmination of the development effort at the site; rather it is the most expensive piece of equipment that will provide essential information for a civilian power programme. It is evident that if the programme were not rushed to such an extent, HERO and the string of stacks could have been dispensed with. But considering the cost of the prototype—£9 million—and the cost of the smaller experiments, this may be the best investment. With the backing of other equipment, the AGR will be used without interruption for two tasks which can be performed only with a full-scale prototype: fuel element evaluation and the accumulation of operating experience. The first loading will contain both fuel element types that are being developed: 20 per cent will be stainless-steel clad, and 80 per cent beryllium-clad fuel-pin assemblies in a graphite sleeve.

Beryllium and Stainless Steel

Externally the stainless steel and beryllium assemblies are indistinguishable, but owing to differences in thermal conductivity, and machining techniques, the design of the fuel pins differs considerably. The cylindrical pellets of uranium oxide are contained in thin tubes with double welded end-caps. The beryllium tubes are produced from small silver plated cylindrical billets by extrusion. At the start of the programme the maximum extrusion length was thought to be about 12 in, hence three beryllium cans are used end-to-end where only two stainless steel clad rods suffice. With more experience it is now felt that beryllium could also be fabricated in 18 in lengths, but a change in design is not warranted. The stainless steel tubes, much more easily fabricated, have small surface projections to improve heat transfer. This cannot be applied conveniently to beryllium—as a result of better heat transfer the stainless steel tubes are 0·4 in, whereas the beryllium tubes are only 0·3 in in diameter. The expected fuel burnup is in the region of 10,000 MWd per tonne, but of course the whole purpose of the AGR is to verify this particular figure.

Principle of Separate but Equal Facilities

Two irradiated fuel inspection lines are being installed, one adjacent to the reactor where complete assemblies will be examined, the other in a second disused blowerhouse for the dismantling and metallurgical examination of individual pins. Each faulty element will be isolated and the exact conditions of failure determined for a statistical correlation of irradiation and modes and rate of failure. Provision is made to measure the amount of interstitial gas contained in the fuel and the amount of free gas accumulated in the can. One or two fuel element strings consisting of three assemblies each will be processed routinely every week in addition to detected failures. The installation of separate irradiated fuel element facilities—the adjacent Windscale plant is fully equipped to handle large volumes of irradiated fuel from the civilian reactors—is justified on the ground that the composition of AGR fuel is different from the Magnox fuel elements, and that the primary purpose of the AGR project is fuel element testing.

AGR Containment May Ease Problems of Siting

Although the Advanced-Gas-cooled Reactor will be enclosed in a containment vessel designed to withstand the pressure rise from the worst credible accident, it is felt that this precaution will not be necessary once the reactor is fully developed. But an advanced gas-cooled reactor core will be much more compact than the core of the present series of reactors. The cost of containment will be relatively small, and Sir William Cook has suggested that future siting difficulties might be eased if the CEGB would agree to pay for containment. Halving the potential hazard might permit siting quite near populated areas, and the extra cost of containment might be easily recovered through improved location and shortened transmission lines.

Process Heat Application at Calder Hall

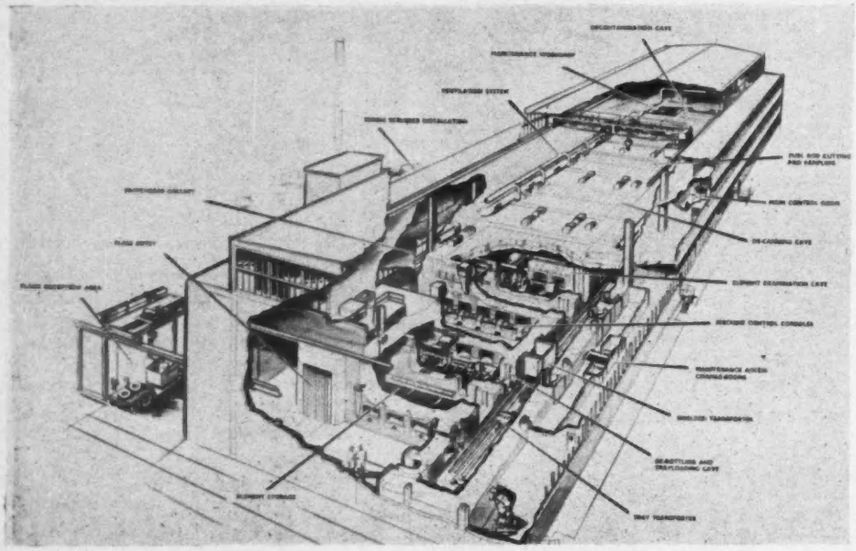
What may be the first commercial application of nuclear process heat is being planned at Calder Hall. Although not yet officially released, the project is in an advanced stage, involving the use of primary steam from the Calder Hall reactors in the Windscale chemical plant. The opportunity for process heating arose from a curious set of circumstances. The thermal output of the Calder Hall reactors has been gradually raised from 180 to 215 MW by raising the operating temperature slightly—from 400 to 418° F—and making use of hidden blower capacity. But neither the turbines nor the generating equipment are capable of absorbing all the excess power. The turbines will be re-bladed to produce an extra 2 MW(e) during the regular shut-down periods, absorbing some 10 MW(t). But the rest, some 25 MW(t) from each reactor, is available at the site, and an economic analysis showed that it would be cheaper to utilise the steam for process heating than to install a new boiler plant.

Fuel Processing Plant for Civil Reactor Project

The expected volume of fuel to be reprocessed from the civilian reactor programme will be about 6,000 elements a year, requiring extensive handling facilities. The plant will be installed in the blower house of No. 2 Windscale Pile (Atomic Review, 6 May '60) and the design and provision of the equipment has been awarded to E. G. Irwin and partners. The installation, which is shown above, required a strengthening of the foundations to take a load of 20,000 tons instead of the original design value of 5,000 tons. Elements will arrive at the laboratory from the Central Electricity Generating Board in bottles and from the Authority in flasks of various sizes, the biggest containing 24 elements and weighing 28 tons. These are placed on a bogie by a 40-ton travelling crane and are taken through specially designed steel rotating doors which, when open to receive the flasks allow entry into the irradiated areas. The elements and bottles are removed from the flasks by a specially designed telescopic grab. The elements are then placed in the store which is cave No. 1 and differs from the rest in that the walls are 5 ft 6 in thick and the windows are of solid glass as a safety measure. The bottles are passed to a de-bottling machine which removes the elements; these are passed to other machines for the removal of graphite parts, then the bare element is placed in the store.

Continuous Process Replaces Manipulation

From the store the elements are moved to the burst can detection units, visual examination and X-ray. After this they are returned to the store. When the diagnosis is known, faulty elements are taken from the store and placed on trays which remain with them during their journey through the rest of the laboratory. Some of the processes to which the elements are subjected are: de-capping, de-canning and rod-removal; can cleaning and can-sectioning for metallurgical purposes. The rod itself is measured, the density determined and sections cut. The samples obtained are transported in flasks to the metallographic lines. Up to the present time the handling of elements has been dealt with mainly by "master slave manipulators." But, because of the time cycle required—no operation must take more than 20 minutes—a more efficient handling system had to be evolved. In all 20 special machines have been designed. All of them have a standard base in which are fitted all the electrical, air and water connections, providing operating flexibility.



The civil reactor programme will require fuel processing facilities capable of handling 6,000 elements a year.

Notes and News

Industrial Collaboration with UKAEA

The first agreement for collaboration between the UKAEA and private industry has been signed with two companies, W. J. Fraser and Company and Nuclear Chemical Plant. The collaboration and licence agreements cover plant and processes connected with the production of uranium metal billets from uranium ore concentrates, and the reprocessing of irradiated nuclear fuel elements. In return for royalties, the Authority licenses certain processes, gives advice and technical assistance and provides facilities for staff training.

Contracts for Nuclear Chemical Plant

As noted above, W. J. Fraser and Company, Limited, have signed a collaboration and licence agreement with the UKAEA enabling them to design and manufacture radioactive chemical plant. W. J. Fraser and Company have already undertaken work for the UKAEA in connection with radioactive chemical plants, have completed a consulting engineering contract for Eurochemic on problems associated with their highly active effluent, and are currently completing the construction of the active effluent treatment plant for Rolls-Royce Limited.

Plasma Spray-Coating for Fuel Elements

Plasma spray-coating techniques have been developed at the Advanced Technology Laboratories of the USAEC for depositing uranium dioxide on stainless steel surfaces. The fuel coated steel can then be incorporated in advanced fuel elements. One suggestion is to form flat fuel plates by welding two coated stainless steel sheets together around the edges, coated side turned inwards. It is hoped that high density plasma-sprayed uranium oxide would adhere to the steel surface even under conditions of severe thermal shock, and would show greatly improved heat transfer properties, as a result of improved density, and excellent bonding. In spraying tests performed with zirconium dioxide, a tensile strength of 230 to 260 lb per sq. in was measured between stainless steel and coating. The technique was described by M. J. Whitman of the USAEC at the fuel element fabrication symposium in Vienna, on May 13.

Formation of Nuclear Energy Group

The Institution of Mechanical Engineers has formed a Nuclear Energy Group to further the opportunities for discussion and the dissemination of information on nuclear matters. The Nuclear Energy Group has issued an invitation to all members of the Institution to register with the Group.

CAREERS WITH

KELLOGG INTERNATIONAL CORPORATION

As a result of a continuing demand for our services in petroleum and petrochemical engineering we invite applications for the following positions:

ARCHITECTURAL ASSISTANT

A.R.I.B.A. applicants preferred with 5/7 years' experience on industrial buildings, power houses, etc., aged between 30 and 40.

INSTRUMENT ENGINEER

Candidates must have University Degree with four years' experience or H.N.C. with six years' experience, which should be, preferably, in refinery process instrumentation. Operating experience would be an advantage. Duties of the successful applicant will cover the preparation of process control diagrams, instrument specifications and data sheets, and the selection and location of instruments.

INSTRUMENT DESIGNER/ DRAUGHTSMEN

Applicants should have at least 3/4 years' experience in Instrument Piping and Wiring Design, Panel Layout and Material Take-Off, and possess O.N.C. in Mechanical or Electrical Engineering. Preference will be given to applicants holding H.N.C.

PIPING DESIGNERS

Top positions are available with us in this field. Consideration will be given only to men who have sound experience in piping design and layout of refinery and chemical plants, or in related industries. Our Piping Designers are of a high standard and we therefore can consider only men of equal calibre.

PRESSURE VESSEL DESIGNER/DRAUGHTSMEN

These positions require knowledge of the British and American Codes and experience in design of pressure vessels such as refinery fractionating towers and/or boiler steam drums, possession of H.N.C. with knowledge of strength of materials, welding, etc. Design office experience essential preferably with these items, but ability and experience in any other similar lines will be useful and will be given full consideration.

ELECTRICAL/DRAUGHTSMEN

Applicants should have O.N.C. with 2 years' experience of layout of power and lighting distribution in petroleum, petrochemical or similar plants.

All these positions are permanent and offer well-paid careers with scope for advancement in a Company whose reputation is well known in the Petrochemical industries. Salaries are commensurate with academic qualifications and industrial experience. Free luncheon vouchers, contributory pension scheme, free life insurance benefits, generous overtime payments and a five-day week. House purchase assistance scheme available. Extra holidays for length of service. This year's holidays honoured.

Please write, giving details of age and experience, etc., to Mr. R. H. Paterson,

KELLOGG INTERNATIONAL CORPORATION

7-10 CHANDOS STREET, LONDON, W.1.

Please quote reference: 161/*H*

C 289

'Engineering' Appointments Section

LANCHESTER COLLEGE OF TECHNOLOGY, COVENTRY.

(PRINCIPAL: A. J. RICHMOND, B.Sc. (Eng.) (Lond.), Ph.D., M.I.Mech.E.)

LECTURER IN PRODUCTION ENGINEERING

Applications are invited for the above post, duties to commence 1st SEPTEMBER, 1960, if possible.

The Department moves into new buildings with entirely new and extensive equipment this summer and an opportunity exists for a keen person to share in the development of full-time and part-time courses and of research activities.

Candidates should have had industrial experience in one or more branches of Production Engineering and be corporate members of an appropriate Institution. Previous teaching experience not essential.

Salary (Men): £1370 by £35 (4) and £40 (1) to £1550 p.a.

In certain circumstances, candidates may be paid a commencing salary about the minimum of the scale. Women receive slightly less at present, but equal pay will apply from April, 1961.

Further particulars and application forms may be obtained by sending a stamped addressed foolscap envelope to the REGISTRAR, LANCHESTER COLLEGE OF TECHNOLOGY, temporary address: BUTTS, COVENTRY, to whom completed forms should be returned by 24th JUNE.

W. L. CHINN,
DIRECTOR OF EDUCATION.

C 255

THE UNIVERSITY OF MANCHESTER

Applications are invited for up to four posts of LECTURER IN ENGINEERING (CIVIL). It is desired to make appointments from applicants particularly interested in any of the fields of Hydraulics, Soil Mechanics, Structural Concrete, Metal Structures and Surveying. The salary scale is £1050 to £1850, with initial salary according to qualifications and experience. Membership of F.S.S.U. and Children's Allowance Scheme. Applications should be sent not later than JUNE 25th, 1960, to the REGISTRAR, THE UNIVERSITY, MANCHESTER 13, from whom further particulars and forms of application may be obtained. Applications by airmail letter in the first instance will be considered from overseas candidates. C 258

UNIVERSITY OF NOTTINGHAM

DEPARTMENT OF CIVIL ENGINEERING

Applications are invited for two vacant LECTURESHIPS IN CIVIL ENGINEERING. Salary within the scale £1050 by £50 to £1400 by £75 to £1850 according to qualifications and experience, with membership of the Universities Superannuation Scheme and children's allowances. Conditions of appointment and form of application, to be returned by 30th JUNE, from the REGISTRAR. C 257

ASSISTANT ENGINEER

Applications are invited for a new appointment of ASSISTANT ENGINEER on the staff of the Superintendent Engineer, responsible for general duties in connection with the engineering services throughout the Group and with a special interest in the new hospital being built at Harlow, Essex. Candidates must have completed an apprenticeship, or have acquired a sound practical training, in mechanical engineering. Practical experience of engineering maintenance under the supervision of an experienced engineer after the completion of initial training will be an advantage. Preference given to candidates possessing a recognised technical qualification. Salary scale, £570 by £25 (4) by £30 (1) to £700 per annum, but consideration will be given to a higher starting point in respect of relevant experience since completion of practical training.

The post offers an excellent opportunity for obtaining increased responsibility and experience, and there is a distinct possibility of promotion becoming available for the right man.

Applications, in writing, with names and addresses of two referees, giving full details of age, training, experience and qualifications, to reach THE GROUP SECRETARY, EPPING GROUP, H.M.C., "OAK COTTAGE," THE PLAIN, EPPING, ESSEX, by 24th JUNE, 1960. C 256

SURREY EDUCATION COMMITTEE

KINGSTON TECHNICAL COLLEGE

PASSETT ROAD, KINGSTON-UPON-THAMES

DEPARTMENT OF ELECTRICAL ENGINEERING

SENIOR LECTURER or LECTURER, depending upon qualifications and experience, required for 1st SEPTEMBER, 1960, or as soon thereafter as possible.

Applicants should possess a degree in Electrical Engineering and appropriate professional qualifications, together with teaching and industrial or research experience. The Department requires for this post a person who is prepared to teach in a wide range of Electrical Engineering subjects to Final Year Degree and Higher National Diploma level.

Salary scales for the above posts in accordance with the Burnham Technical Report, 1959, plus London Allowance:—

Senior Lecturer ... £1550 by £50 to £1750.
Lecturer ... £1370 by £35 (£40) to £1550.

Further particulars for each post and application form from the PRINCIPAL on receipt of stamped addressed envelope. C 280

ELECTRICITY CORPORATION OF NIGERIA

LONDON OFFICE

VACANCY FOR ASSISTANT RESIDENT ENGINEER

Applications are invited from suitably qualified Nigerians now resident in the United Kingdom, France or Germany, for appointment as Assistant Resident Engineer in the London Office of the Electricity Corporation of Nigeria.

QUALIFICATIONS:

A degree in Electrical or Mechanical Engineering from a recognised University or its equivalent.

EXPERIENCE:

Candidates should have at least two years practical experience.

SALARY SCALE:

Corporation Salary Scale 12.

Basic Salary, £945 by £45 to £1125 by £54 to £1449 per annum plus 11½ per cent Interim Award.

Overseas Allowance: £740 per annum married; £410 per annum single.

The basic salary scale is under review at the moment. The point of entry will be determined according to the successful candidate's qualifications and experience.

DUTIES:

The successful applicant will on appointment be required generally to assist the Resident Engineer on:—

(*a*) Inviting and assessing tenders for the purchase of electrical equipment, and making recommendations on them to Headquarters.
(*b*) Placing and progressing of orders.
(*c*) Liaison with Consulting Engineers on major projects.

CONDITIONS OF SERVICE:

The appointment will be on pensionable or contract terms.

The successful candidate should be prepared to make a career of the appointment and will very likely be permanently based in London.

METHOD OF APPLICATION:

Application forms, which can be obtained from the Resident Engineer, London, should on completion be returned to him,
c/o ELECTRICITY CORPORATION OF NIGERIA,
ADELPHI (4th Floor),
JOHN ADAM STREET,
LONDON, W.C.2.
not later than the 31st JULY, 1960.

C 276

BRITISH OXYGEN GASES LIMITED

ELECTRICAL ENGINEER

An electrical engineer between 25 and 30 years of age is required for interesting development work in connection with power units and control gear for inert gas welding. A knowledge of electronics is an advantage, and the candidate should possess a degree or H.N.C. in electrical engineering.

TECHNICAL ASSISTANTS

Technical Assistants are also required in the age range 25-30. They should have an electrical background and a H.N.C. in electrical engineering would be preferred. Candidates should have a knowledge of electronics or development experience in industry.
There are good future prospects and very good commencing salaries are offered. Housing assistance is available if required. Please reply stating full particulars to the:—

PERSONNEL MANAGER,
SPENCER HOUSE,
ST. JAMES'S PLACE,
LONDON, S.W.1.

C 297

GKN

The Guest Keen and Nettlefolds Group of Companies wish to make the following appointment in one of their constituent companies

QUALITY CONTROL ENGINEERS

A company in the Midlands which is engaged in high precision machining work on a wide range of increasingly important products for the vehicle and other industries requires suitably qualified engineers to implement a Statistical Quality control system.

Applicants in the 24-35 age bracket should have reached O.N.C. or H.N.C., or equivalent standards, in Mechanical or Production Engineering and must have had training and practical experience in quality control work.

Applicants who consider that they have had relevant experience are invited to write, stating full details of age, qualifications, career to date, etc., to the

**Group Personnel Officer,
Guest Keen & Nettlefolds Ltd.,
66, Cannon Street,
London, E.C.4.**

All applications will be regarded as strictly confidential.

C 270

UNIVERSITY COLLEGE OF GHANA

POST-GRADUATE ENGINEERING RESEARCH UNIT

Applications are invited for the post of **CHIEF TECHNICIAN.** Candidates should have suitable qualifications, preferably Higher National Certificate, and/or a minimum of seven years' experience in charge of Civil or Mechanical Engineering research laboratory or workshop.

Four year contract. Salary (under review) not less than £G1,100 p.a. plus a gratuity of £G150 p.a. in lieu of superannuation. Family allowance £G100 p.a. per child (maximum £G500). Outfit allowance £G60. Passages for appointee and family on appointment, leave and completion of contract. Part-furnished accommodation at not more than 7.5 per cent of salary.

Applications (six copies), naming three referees, should be sent within two weeks of the appearance of this advertisement to the ASSISTANT REGISTRAR (LONDON), UNIVERSITY COLLEGE OF GHANA, 29, TAVISTOCK SQUARE, LONDON, W.C.1, from whom further particulars may be obtained.

C 294

CENTRAL ELECTRICITY GENERATING BOARD

Applications are invited for the post of

ASSISTANT ENGINEER (MECHANICAL PLANNING)

AT INCE POWER STATION, ELTON, NEAR CHESTER.

To supervise maintenance records and safe custody of drawings. A sound technical training and practical experience at junior level, of plant operation and maintenance is desirable.

Possession of a Higher National Certificate (Mechanical) is desirable. Salary scale £910/955.

Applications in writing, stating age, experience, etc., should be forwarded to the Establishments Officer, Central Electricity House, 825, Wilmslow Road, Manchester 20, by 15th June, 1960. Please quote vacancy No. E.96/290/E.

C 274

QUALIFIED MECHANICAL ENGINEER

A large organisation with interests in the packaging field has a vacancy for a qualified Mechanical Engineer to take charge of a number of engineers engaged in process development. This is a senior position involving responsibility for technical guidance and control of staff engaged on development projects.

Applicants must have a university degree or A.M.I.Mech.E., and be preferably within the age group 30-40 with several years' experience in process development work.

All replies treated in confidence.—Write for application form to BOX C 268, Offices of ENGINEERING.

THE UNIVERSITY OF MANCHESTER

Applications are invited for the post of LECTURER IN NUCLEAR ENGINEERING. Candidates should be graduates in engineering or physics; experience of experimental reactor physics or heat transfer would be an advantage. The successful candidate will take part in teaching and research in the Nuclear Engineering Laboratory. University regulations permit teaching staff to read for the degrees of M.Sc. and Ph.D. Applications will also be considered from engineers and physicists who would be interested in a temporary appointment of two or more years. The salary scale is £1050 to £1850 per annum. Membership of the F.S.S.U. and Children's Allowance Scheme. Initial salary according to qualifications and experience.—Applications should be sent not later than June 18, 1960, to the REGISTRAR, THE UNIVERSITY, MANCHESTER 13, from whom further particulars and forms of application may be obtained. Applications by airmail letter in the first instance will be considered from overseas candidates.

C 214

THE ROYAL TECHNICAL COLLEGE OF EAST AFRICA

AND PROPOSED UNIVERSITY COLLEGE IN NAIROBI

Applications are invited for:
CHAIR OF CIVIL ENGINEERING
CHAIR OF ELECTRICAL ENGINEERING

Salary scale: £2550 by £75 to £2700 p.a. Superannuation. Child allowance £50 p.a. per child (max. £150 p.a.). Passages for appointee and family (up to four adult passages) on appointment, termination and leave (once every two years). Rent according to quarters provided £60-£114 p.a. Detailed applications (8 copies) naming 3 referees, by 30th JULY, 1960, to SECRETARY, INTER-UNIVERSITY COUNCIL FOR HIGHER EDUCATION OVERSEAS, 29, WOBURN SQUARE, LONDON, W.C.1, from whom further particulars may be obtained.

C 271

HOME OFFICE

MECHANICAL ENGINEERING DRAUGHTSMAN

One unestablished post at Supply and Transport Branch, Kingston By Pass Road, Surbiton, Surrey, for man or woman aged at least 20. Candidates must have an Ordinary National Certificate or an equivalent or higher qualification and must have satisfactorily completed a normal apprenticeship or pupilage, or have had equivalent training of not less than three years' duration. Experience: at least one year's employment in a Drawing Office additional to the training period specified above. Salary (National scale), £550-£875. Write for application form to ESTABLISHMENT OFFICER, ROOM 308, HOME OFFICE, WHITEHALL, S.W.1, not later than 24th JUNE, 1960.

C 286

THE UNIVERSITY OF MANCHESTER

Applications are invited from graduates in Physics, Chemistry, Metallurgy, Biology or Engineering for the post of ASSISTANT LECTURER IN DENTAL MATERIALS. The person appointed will be concerned with work on the properties of dental materials. Applications would be considered from persons intending to graduate in 1960. There is wide scope for research in this field and ample facilities are available. Salary on a scale (at present under review) £700 to £850 per annum with membership of F.S.S.U. and Children's Allowance Scheme.—Applications should be sent not later than JUNE 18th, 1960, to the REGISTRAR, THE UNIVERSITY, MANCHESTER 13, from whom further particulars and forms of application may be obtained.

C 200

CENTRAL ELECTRICITY GENERATING BOARD

NORTH EASTERN AND YORKSHIRE REGION

FOURTH ASSISTANT ENGINEER EFFICIENCY AND TESTING

Applications are invited for the position of FOURTH ASSISTANT ENGINEER in the Efficiency and Test Section of the GENERATION OPERATION DEPARTMENT, YORKSHIRE DIVISIONAL HEADQUARTERS, LEEDS.

Applicants should be educated to at least Higher National Certificate standard in Mechanical Engineering, and should preferably have had experience of operation in modern power stations.

Duties will include the testing of power station plant throughout the Division, and the preparation of reports. The successful applicant will be based at Skelton Grange Power Station but will be expected to travel in connection with his duties.

The salary for the appointment will be in accordance with the National Joint Board Agreement, Schedule " B," Grade 8 (£735-£960 per annum) and will be subject to the provisions of the Board's Superannuation Scheme.

Forms of application may be obtained from any office of the Board or from the ASSISTANT REGIONAL SECRETARY (PERSONNEL), CENTRAL ELECTRICITY GENERATING BOARD, NORTH EASTERN AND YORKSHIRE REGION, 1 WHITEHALL ROAD, LEEDS, 1, to whom they should be returned to arrive not later than the 27th JUNE, 1960.

C 282

BRITISH RAILWAYS

(WESTERN REGION)

require

TECHNICAL ASSISTANTS experienced in the design of steel bridges and other structures to fill vacancies with a salary range £875/948.
Superannuation Fund.
Reduced rates of travel and other concessions.
5-day week.
Applications, giving qualifications, age and experience, to:—

CHIEF CIVIL ENGINEER,
BRITISH RAILWAYS,
WESTERN REGION,
PADDINGTON STATION,
LONDON, W.2.

C 261

MIDDLESEX COUNTY COUNCIL EDUCATION COMMITTEE

ENFIELD TECHNICAL COLLEGE QUEENSWAY, ENFIELD, MIDDX.

Required for 1st SEPTEMBER, 1960, or as early thereafter as possible—

LECTURER IN ELECTRICAL ENGINEERING to teach Electronics and Radio Communication to the standard of the Higher National Diploma and I.E.E. Part III Examinations. Candidates should be University Graduates in Electrical Engineering and preferably be Corporate Members of the Institution of Electrical Engineers. They should have had good industrial experience.

LECTURER IN MECHANICAL ENGINEERING to teach Mechanical Engineering subjects up to Higher National Diploma standard. Candidates must have a University Degree in Engineering and should preferably be Corporate Members of the Institution of Mechanical Engineers. They should have had industrial and teaching or research experience.

Salary within the range: £1408-£1601 per annum.

Application forms (foolscap s.a.e.) from the PRINCIPAL, to whom completed forms should be returned within 14 days of the appearance of this advertisement.

C. E. GURR, M.Sc., Ph.D.,
SECRETARY TO THE EDUCATION COMMITTEE.

C 295

NOTTINGHAMSHIRE COUNTY COUNCIL: EDUCATION COMMITTEE

ARNOLD AND CARLTON COLLEGE OF FURTHER EDUCATION

DIGBY AVENUE, MAPPERLEY, NOTTINGHAM

(Principal: C. E. Skinner, B.Sc., A.Inst.P.)

This is a new College in new buildings, Phase I of which will open next September. APPLICATIONS are invited for the appointment of an ASSISTANT LECTURER, GRADE B, in GENERAL ENGINEERING SUBJECTS, to commence 1st September, 1960, or as soon thereafter as possible. Candidates should be qualified in Mechanical Engineering, preferably with a Mining background. Experience in teaching General Engineering Subjects to Mining National and General Certificate Courses is desirable. Ability and willingness to assist in the teaching of Workshop Technology and Workshop Practice is expected. Good industrial experience will be an advantage. Salary: Burnham Technical Scale: £700 by £27 10s. 0d. (15) by £37 10s. 0d. (1) to £1150 per annum. There are additions for approved qualifications and training and, to determine the point of entry, increments will be given for War/National Service and approved industrial experience. For forms and further particulars send foolscap s.a.e. to the undersigned. Closing date 14th JULY, 1960.

J. EDWARD MASON,
DIRECTOR OF EDUCATION.
County Hall.

C 292

NORTHAMPTON COUNTY BOROUGH EDUCATION COMMITTEE

NORTHAMPTON COLLEGE OF TECHNOLOGY

Applications are invited for the appointment of a full-time LECTURER IN PRODUCTION ENGINEERING, duties to commence 1st September, 1960, or as soon as possible thereafter. Candidates should be graduates or hold equivalent qualifications with suitable industrial and teaching experience and be able to teach Principles of Engineering Production and allied subjects to Higher National Certificate and Final City and Guilds standard.

Forms of application and further particulars may be obtained from the undersigned to whom applications should be returned within two weeks of the appearance of this advertisement.

H. A. SKERRETT, CHIEF EDUCATION OFFICER, "SPRINGFIELD," CLIFTONVILLE, NORTHAMPTON.

C 291

SOUTH OF SCOTLAND ELECTRICITY BOARD

Applications are invited for a superannuable appointment as an ASSISTANT HEATING AND VENTILATING ENGINEER in the Development Section of the Chief Commercial Officer's Department at Board Headquarters.

Duties will comprise the design of space heating and ventilation schemes including hot water central heating using electrode boilers and similar equipment.

Candidates should have a sound technical training in heating and ventilation. Experience in the preparation of estimates, specifications and drawings for central heating plants is required. Qualifications leading to membership of the Institution of Heating and Ventilation Engineers are desirable.

Salary, N.J.B., Class AX/EX, Grade 7—£840/£1065 per annum.

Applications, on the standard form and quoting reference number C4/60, should be submitted to the SECRETARY, SOUTH OF SCOTLAND ELECTRICITY BOARD, INVERLAIR AVENUE, GLASGOW, S.4, not later than 27th JUNE, 1960.

C 299

SENIOR LECTURERS AND LECTURERS

SENIOR LECTURERS AND LECTURERS in Civil or Mechanical Engineering required by ROYAL MILITARY COLLEGE OF SCIENCE, SHRIVENHAM, BERKS. Teaching at university level and involves both lecturing and laboratory work for the London Ext. B.Sc. (Eng.). Extensive well-equipped laboratories and research encouraged. QUALIFICATIONS: First or second class honours degree. Candidates should be qualified to teach Fluid Mechanics, Mechanics of Machines or Applied Thermo Dynamics. SALARY RANGE: Senior Lecturer (male), £1166-£1380, Lecturer £615-£1090. In determining starting salary, credit will be given for post-graduate experience and National Service. SUPERANNUATION F.S.S.U. good prospects of permanency. Residential officers' mess for single men; possibility of house for married men.—Application forms from MINISTRY OF LABOUR, TECHNICAL AND SCIENTIFIC REGISTER (K), 26, KING STREET, LONDON, S.W.1, quoting C.485/OA.

C 301

APPOINTMENTS OPEN

DRAUGHTSMEN

An opportunity for gaining experience in factory services, plan layout and machinery development exists for draughtsmen, around the age of 20-23 years, with Schweppes Engineering Department. Applicants should have served an apprenticeship, or have equivalent workshop experience followed by at least two or three years' drawing experience, preferably on the works engineering side. O.N.C. or study towards it would be an advantage.—Apply in writing with brief details of training and experience, stating present salary, to ASSISTANT PERSONNEL MANAGER (REF. MRL), SCHWEPPES HOUSE, CONNAUGHT PLACE, W.2. C 288

TECHNICAL ASSISTANT

TECHNICAL ASSISTANT required for Development work in connection with motor vehicle fuel systems. O.N.C. level essential together with some design drawing experience. Knowledge of hydraulics and engine testing desirable.—Written applications should be addressed to PERSONNEL MANAGER, SIMMS MOTOR UNITS LTD., EAST FINCHLEY, LONDON, N.2. C 287

ELECTRICAL ENGINEER

ELECTRICAL ENGINEER required by large textile group in Dundee and district. This appointment is at Managerial level, and the man selected will be directly responsible to the Chief Engineer for the planning, installation and maintenance of all electrical plant and equipment in the group. The post is salaried and superannuated. Applicants should be Corporate Members of the Institution of Electrical Engineers.—Apply, giving full particulars of age, experience and qualifications, to the STAFF MANAGER, JUTE INDUSTRIES LTD., MEADOW PLACE BUILDINGS, DUNDEE. The closing date for applications will be 22nd JUNE, 1960. C 281

DETAIL AND SCHEME DRAUGHTSMEN

Detail and Scheme Draughtsmen required. Experienced Sheet Metal Work for Ventilating and Dust Recovery Plants, etc.—'PHONE: VISCO CRO. 4181. C 245

DESIGN ASSISTANT

DESIGN ASSISTANT required by Marine Engineering Company, in Clyde area for work on Turbine and Oil Engine Machinery. Knowledge of Torsional Vibration problems, estimation of power requirements for ships, Propeller design and preparation of Heat Flow Charts, etc., desirable.

Applicants should be capable of working on own initiative with minimum supervision and preferably hold an Engineering degree or equivalent.

Superannuation Scheme available after qualifying period of satisfactory service. Please state fully experience, age and qualifications.—Write 2755, WM. PORTEUS & CO., GLASGOW. C 252

ELECTRICAL DRAUGHTSMAN

ELECTRICAL DRAUGHTSMAN required with H.N.C. or equivalent. Knowledge of factory installation work desirable. Non-contributory pension scheme.

Excellent canteen facilities.

Food factory in London area.

State experience and salary required.—BOX C 279, Offices of ENGINEERING.

METALLURGIST OR CHEMIST

QUALIFIED METALLURGIST or CHEMIST required for development work and research on mechanised welding processes. Initiative essential, some industrial experience and knowledge of arc welding procedures desirable. Excellent working conditions, good salary and prospects.—Apply MUREX WELDING PROCESSES LIMITED, HERTFORD ROAD, WALTHAM CROSS, HERTS. C 277

ASSISTANT ENGINEER

BRITISH MANAGED PULP AND PAPER MILL in India requires ASSISTANT ENGINEER not over 40 years of age. Progressive position with prospects of further promotion for an applicant with experience in maintaining modern Fourdrinier Paper Machines and auxiliaries, Pulp Preparation Plant, Power Plant, etc. Good salary offered with leave on full pay and free passages, free quarters, medical attention and membership of superannuation and Provident Funds.—Please reply to BOX NO. 3448, c/o CHARLES BARKER & SONS LIMITED, GATEWAY HOUSE, LONDON, E.C.4. C 272

TECHNICAL JOURNALIST

EXPERIENCED TECHNICAL JOURNALIST, with special knowledge of machine tools, required to write feature articles on engineering workshop practice.—Write BOX C 300, Offices of ENGINEERING

RESIDENT ENGINEER

RESIDENT ENGINEER for reconstruction of the Swing Bridge at Caernarvon. Approximately 9/12 months appointment commencing July/August, 1960. Experience of welding essential. Salary £1000 per annum plus expenses allowance.—Applications giving full details of experience should be forwarded to the CONSULTING ENGINEERS, F. R. BULLEN & PARTNERS, DACRE HOUSE, DEAN FARRAR STREET, LONDON, S.W.1. C 244

SENIOR DESIGN ENGINEER

Hydraulic Press Manufacturer requires SENIOR DESIGN ENGINEER to take charge of small expanding design office. Preferment given to man with broad experience in Press design, coupled with initiative and originality.—Write giving details of age, experience and salary required to BOX C 229, Offices of ENGINEERING.

GEAR DESIGN ENGINEER

Gear design engineer required with experience marine gearboxes or V.P. propellers. Vacancy is in busy and expanding Technical Department, where good salary will be paid for the right man, having H.N.C. or equivalent. Existing holiday arrangements respected. Superannuation scheme. Free life insurance.—Apply: TECHNICAL MANAGER, MODERN WHEEL DRIVE, LTD., LINDO LODGE, STANLEY AVENUE, CHESHAM, BUCKS. C 232

AN ENGINEERING COMPANY

serving the Gas, Petroleum, Chemica and Steelmaking industries requires a

CHARTERED CIVIL ENGINEER

Candidates should be preferably 30/35 years of age with contracting and design office experience. Employment at first will be in the company's drawing office with opportunities later to take charge of projects operated from Head Office or from field project offices at home and overseas. Pension scheme. Assistance with housing.

Details of training, experience and salary required to BOX C 198, Offices of ENGINEERING.

ASSISTANT PROJECT ENGINEERS

An opportunity exists for TWO ASSISTANT PROJECT ENGINEERS to work with a small enthusiastic team on the planning and installation of new machinery to suit existing and new processes being developed. The work would cover the improvement of existing factories and machinery, and the planning and supervising of complete process plant installations in some twenty factories in Great Britain. Only applicants having an engineering degree or Higher National Certificate approaching A.M.I. Mech.E. standard with at least two years' practical training and some drawing office experience, preferably on the works engineering side, will be considered. Approximate age limits 28-35. The successful applicants would be based in London but expected to travel to all factories.—Applications in writing giving brief details of experience, present position and salary should be addressed to ASSISTANT PERSONNEL MANAGER (Ref. MRL), SCHWEPPES LIMITED, SCHWEPPES HOUSE, 1-6, CONNAUGHT PLACE, LONDON, W.2. C 259

ENGINEERING GRADUATES

Forensic Engineers invite application from ENGINEERING GRADUATES with good background and industrial experience for responsible and individualistic post. Age not over 35.—BOX C 260 Offices of ENGINEERING.

WANTED FOR SOUTH AFRICA

PLANNERS, RATEFIXERS AND ESTIMATORS required by leading firm of Heavy Engineers in South Africa manufacturing for—

MINING INDUSTRY: Winders and Reduction Plant.

STEEL INDUSTRY: Rolling Mills and Auxiliary Equipments.

PETROLEUM AND CHEMICAL INDUSTRIES: Pressure Vessels and Heat Exchangers.

POWER SUPPLY INDUSTRY: Condensers and Circulating Pumps.

Applicants must have a minimum of five years' experience as Planners, Ratefixers or Estimators in the heavy engineering industry, and preference will be given to those who have specialised in the above-mentioned fields. Salary in accordance with ability, experience and qualifications. Liberal leave with additional long service benefits after six years. Medical benefit and Pension funds. Housing and assisted passage facilities available.

Apply in writing, giving full details of age, experience, qualifications and marital status and enclosing a recent photograph, to:—

THE LONDON REPRESENTATIVE
VANDERBIJL ENGINEERING CORPORATION, LTD.,
723-737, THE ADELPHI
JOHN ADAM STREET
LONDON, W.C.2 C 216

SIEMENS

have a vacancy for an

ELECTRICAL ENGINEER

FOR GERMAN-ENGLISH TRANSLATIONS

Applications are invited from British-trained engineers with a good general education and sound technical training, preferably also with practical experience in the application of electric equipment. Good working knowledge of German is essential. The ability to write clearly and concisely will be expected of candidates.

A five-day week is worked, with generous holidays. Favourable housing conditions for permanent staff.

Apply, stating age, education, qualifications, experience and salary required, to:—

SIEMENS-SCHUCKERTWERKE AKTIENGESELLSCHAFT

Personalabteilung, Erlangen, Werner-von-Siemens-Straße 50, Germany. C 12

RHODESIAN SELECTION TRUST GROUP

ELECTRICAL AND MECHANICAL ENGINEERS

A large copper mine in the Rhodesian Selection Trust Group requires Senior Engineers. Applicants should hold a degree in Electrical or Mechanical Engineering and have had subsequent experience in heavy engineering work. They should preferably be under 35 years of age.

Duties will consist of planning engineering projects of a varied nature in connection with large scale mining operations including power generation and distribution, mine shafts and haulage, ore treatment, smelting and other associated heavy engineering plant.

Basic starting salary from £1750 p.a. depending on qualifications and experience. There is also a bonus scheme, at present paying 43¾ per cent on basic pay and a variable cost-of-living allowance currently £83 p.a. The company has generous pension, life assurance and medical schemes and it also operates share purchase and house purchase arrangements.

Leave at 51 days p.a. may be accumulated over three years' service.

The outward passages for the employee and his family would be paid by the company.

Full particulars covering age, qualifications and experience, should be sent in confidence to:—

THE OVERSEAS PERSONNEL OFFICER
SELECTION TRUST LIMITED
MASON'S AVENUE
COLEMAN STREET
LONDON, E.C.2
Please quote R.9 Eg. C 247

FORD MOTOR COMPANY LIMITED

require an

ASSISTANT TO ENGINEER—MECHANICAL MAINTENANCE, BLAST FURNACE AND COKE OVENS

Age 25-35—Applicants must have served an apprenticeship in general mechanical engineering and be capable draughtsmen, qualified to prepare working drawings necessary for the continued maintenance of plant. Minimum qualification acceptable O.N.C. Preference will be given to applicants experienced in Blast Furnace and Coke Oven maintenance work. Please apply to

MR. H. C. CRAWFORD,
TRAINING AND RECRUITMENT DEPARTMENT,
FORD MOTOR COMPANY LIMITED,
DAGENHAM, ESSEX.

quoting on the outer cover of the envelope " Reference TBF." C 278

CHIEF INSPECTOR

required for

LARGE COMMERCIAL VEHICLE
FACTORY NEAR LONDON

Applicants must have experience in Modern Production Methods, including Heat Treatment, Sheet Metal Body Welding and Assembly Operations and Finish Painting.

Applicants should be good disciplinarians and not over 45 years of age.

Staff Pension Scheme and Social and Recreation facilities available.

Box No. CR 3475, A.K. ADVG.,
212a, Shaftesbury Avenue, London, W.C.2.

C 293

GKN

The Guest Keen and Nettlefolds Group of Companies wish to make the following appointment at their Research Laboratory

TECHNICAL SECRETARY

The Liaison and Information Division of this Laboratory which serves a Group of over eighty companies requires a Technical Secretary who will act as Liaison Officer. He will be responsible for the technical secretarial work of a number of committees, both in the Laboratory and in the Group, and also for general liaison work including the entertainment of visitors to the Laboratory.

Applicants for this post should preferably be under 30 and have some technical knowledge.

Applications, giving details of age, qualifications, experience, etc., should be addressed to:—

The Recruitment Officer,
G.K.N. Group Research Laboratory,
Birmingham New Road,
Lanesfield,
Wolverhampton.

C 269

THE BURMAH OIL CO. (PIPE LINES) LTD.

Britannic House,
Finsbury Circus, E.C.2

have the following interesting vacancies for ENGINEERS for service in INDIA on a major crude oil pipeline project. Appointments will commence August/September, 1960, and will be on a bachelor basis.

Salaries free of Indian Taxation will be paid in Rupees and will be related to qualifications and experience. Messing and accommodation in India will be provided free.

MECHANICAL ENGINEERS

Candidates should have good experience in the installation, operation and maintenance of diesel engines, pumping plant and similar equipment and should hold 1st Class M.O.T. Diesel certificates or equivalent.

CIVIL/MECHANICAL ENGINEERS

Candidates should be technically qualified and have been employed on large pipeline installations preferably for the transmission of crude oil.

Applications should be addressed to the Company giving full details of qualifications, experience and personal particulars.

C 263

ADVERTISING

If you have **practical experience of designing press advertisements, folders and catalogues** with preferably even slight knowledge of engineering, you are invited to send us, in confidence, a summary of your experience and qualifications. Duties include contact. Write:

MANAGING DIRECTOR,
WALTER PEARCE & CO., LTD.,
2, Queen's Avenue,
Bristol, 8.

C 266

WELDING DEMONSTRATORS AND INSTRUCTORS

required

with experience in oxy-acetylene and/or inert gas welding, 25 to 35 years of age. The work is interesting and includes the possibility of a limited amount of travelling. A sound training will be given to successful applicants. Five-day 37½ hour week, good working conditions, canteen and superannuation scheme. Housing assistance is available if required. Apply in writing to:—

THE MANAGER, S.T.S. DEPARTMENT,
BRITISH OXYGEN GASES LTD.,
NORTH CIRCULAR ROAD,
CRICKLEWOOD, N.W.2.

C 298

A TECHNICAL WRITER

is required by

W. H. ALLEN SONS & COMPANY LTD.

for the preparation and editing of Working Instructions Books for steam turbines, pumps, diesels and electrical machinery.

Applicants should hold, or be studying to obtain a Higher National Certificate (or equivalent) and have the ability to express themselves clearly and concisely.

The Company offers interesting work, excellent conditions of service and comprehensive recreational and welfare amenities. There is a Contributory Pension and Life Assurance scheme in operation.

Applications, which will be treated in confidence, should be made in writing, quoting Ref. No.1701/8, to:

THE PERSONNEL MANAGER,
QUEENS ENGINEERING WORKS,
BEDFORD

C262

APPOINTMENTS WANTED

ASSISTANT SERVICE ENGINEER

To a small organisation where initiative, a critical approach and personal contact are valued, the advertiser will bring a sound knowledge of general plant and after sales service organisation. Twelve years in a supervisory capacity including overseas experience. Present position, Assistant Service Engineer, Gas Turbines. Age 42.—BOX C 275, Offices of ENGINEERING.

HATTERSLEY

ESTABLISHED 1897

HATTERSLEY (ORMSKIRK) LTD.

Head Office and Works:- ORMSKIRK, Lancs.
Works:- HALIFAX, Yorks.

and **BECK & CO. (METERS) Limited**

Offices and Works:- Streatham Vale, London, S.W.16

BRONZE AND CAST IRON VALVES AND THE *Beckmeter* PETROL PUMPS

Extracts from the Consolidated Accounts at 31st March, 1960.

	£		£
Issued Capital ..	1,250,000	Fixed Assets ..	1,645,365
Capital Reserves ..	69,776	Less: Accumulated Depreciation ..	336,845
Revenue Reserves and Unappropriated Profits	1,281,741		1,308,520
	2,601,517	Trade Investments	317,846
Outside Shareholders	304,836	Current Assets ..	2,159,066
Future Income Tax..	230,000		3,785,432
		Less: Liabilities ..	649,079
	£3,136,353		£3,136,353

	1960 £	1959 £
Group Profit before Taxation	656,257	585,941
Taxation	299,116	296,201
Dividends (net)	130,156	112,969
Net Profit retained for Developments, Expansion and Contingencies	173,452	144,244

Extracts from the Statement by the Chairman, Mr. Hubert C. Nicholson, J.P., F.C.A., to be submitted at the 37th Annual General Meeting in Ormskirk on 30th June, 1960.

HATTERSLEY (ORMSKIRK) LIMITED

Trading Conditions—Higher value of orders received and despatched but reduced profit resulting from keen competition and lower profit margins for valves and fittings.

Halifax Extensions—Transfer of Halifax Works to new premises completed but did not contribute materially to production during year.

M. B. John & Hattersley Limited, Australia—Another year of record sales and profits. Dividend maintained at 10 per cent.

BECK & CO. (METERS) LIMITED

Exceptionally good year with record turnover and profit, but figures unlikely to be maintained. Dividend increased from 25 per cent. to 40 per cent. Pump Maintenance Limited still further consolidated its position.

Number of Shareholders: 1,300. Number of Employees: 1,460.

Copies of the full accounts may be obtained upon application to the Secretary.

C 240

Companies

Société, Sociedad, Deutsche and all Babcock & Wilcox

MANY companies have taken or are taking steps to be represented on the continent of Europe. Few if any have the widespread and long established connections of BABCOCK & WILCOX, the boiler makers.

The SOCIÉTÉ FRANÇAISE DES CONSTRUCTIONS BABCOCK & WILCOX, Paris, the DEUTSCHE BABCOCK & WILCOX, Oberhausen, BABCOCK-SMULDERS, Brussels, and SOCIEDAD ESPANOLA DE CONSTRUCCIONES BABCOCK & WILCOX, Bilbao, these are all directly connected with the company. Licensee arrangements have long been in existence with companies in Finland, Denmark, Norway and Sweden, and in Holland and Italy.

Technical and labour difficulties at the company's Renfrew and Dalmuir works caused the output in the early months of last year to fall behind schedule. Later in the year an accelerated pace of work went a long way to overhaul the reduced production but at considerably greater cost than expected. 1959 was the worst year in the company's history for labour troubles.

The Dalmuir factory had been taken over from the Ministry of Supply in January, 1959. Despite a disproportionately high number of stoppages there, output has been increased and more than 800 people added to the payroll.

Mr. W. Lionel Fraser, the chairman, states in his annual review that the year's results are bad, and certainly the profit for the year, before tax, was down from £3,277,626 to £523,154. As Mr. Fraser says, the results do not truly reflect the strength and potentiality of the group.

Order Improvement

By the end of the year the order book was higher than at the start. Outstanding among the improved volume of new business was the single boiler unit with a capacity of 550 MW for the Thorpe Marsh power station of the CENTRAL ELECTRICITY GENERATING BOARD. This one boiler is for a single generating set whose output is greater than that of Battersea power station, which has had 17 Babcock boilers installed in the course of 30 years.

The total value of export orders was not up to the company's hopes, because of intense foreign competition. Useful orders were received from Sweden, Finland, Poland and Roumania. Others were won by the subsidiary companies with their own partial manufacturing facilities—Australia, Mexico and Africa.

RICHARD THOMAS & BALDWINS and COLVILLES have both placed orders for a waste heat boiler of particular interest to steelworks which is to be produced under an arrangement with WAAGNER-BIRO, of Austria.

Among the home subsidiaries, SPENCER-BONECOURT-CLARKSON have kept up the sales of their Steambloc boilers in the field of packaged-boilers, much of their output going overseas.

Now heavily engaged in its nuclear power contracts, at Hinkley Point, at Windscale and at Trawsfynydd, the company has also developed nuclear propulsion plant which could be applied immediately to both naval and merchant vessels.

Reviewing the prospects, Mr. Fraser does not mince words. The fierce competition, the cripplingly low profit margins, the "unhappy" labour situation, are the conditions now facing the boiler industry. The industry also has its excessive capacity.

But Babcock are participating in "a huge and costly pioneering undertaking." As their chairman says, they are a great company and eventually the benefit will be reaped of the enormous volume of capital they and others are pouring into nuclear engineering.

Public and Private Pipeline Positions

The great days of railroad construction through the English countryside have been recalled in the arguments over the powers the Esso Petroleum Company should have to build pipelines from the Fawley refinery, near Southampton, to London Airport and to Avonmouth.

It is important to realise that the objections voiced to the Parliamentary Bill are not simply brought about by enmity to the company's plans. They have been reasoned by Sir Eric Errington, MP for Aldershot, Hants, who is not opposed to the well established practice of petroleum product movement by pipeline. He believes that many people whose interests would be affected do not know in what way it will turn out. Notification of these people should be undertaken and preparation made, in Sir Eric's view, for objections to be dealt with in the way that was used when the railway routes were being laid down.

The present method of distribution for petroleum products in the United Kingdom would be the despair of any efficiency expert who was asked to look them over. The next few years are expected to bring an immense increase in private motoring, and not much less in commercial road transport.

Without pipelines this means more and more road space taken up by enormous tankers at the expense of those whom the petrol companies are trying to serve. London Airport is an especially difficult case. Its fuel is currently shipped from Fawley to Purfleet on the Thames. After a barge journey to Fulham it is taken in 200 tanker journeys a day by road to the airport.

Four of these tankers are needed to refuel a single Boeing 707, an aircraft of a type whose numbers and frequency of calls at London Airport are certain to increase.

Saving Road Space

The pipeline would cut tanker journeys between Fulham and London Airport from 200 to 20 a day.

The obvious public importance of the pipelines for petrol only emphasises the necessity of seeing that all those genuinely affected by their introduction are properly compensated.

The Avonmouth line, of 6 in diameter—the London Airport line would be 12 in—is intended to carry ethylene for use at the new Imperial Chemical Industries Severnside plant. In this case the benefit is primarily one of cutting the cost.

Esso have sent out an illustrated leaflet to all whom it believes are likely to be concerned. They are seeking to pay "easements" according to established practice and compensation for any loss or damage; disagreements to go to arbitration.

BICC Chairman on the Cable Price War

As the largest group of cable manufacturers in the United Kingdom, BRITISH INSULATED CALLENDER'S CABLES last year also had special reason for being thought the leading group, since they led the way out of the chaotic price war by increasing some cable prices.

What increases there were have not yet brought cable making back to overall economic levels, says Mr.

William H. McFadzean, the BICC chairman (inset), in his annual report.

In the year under review the group, which now has 32 factories at home and eleven abroad, added the TELCON and SCOTTISH CABLES companies to its interests. The effect of the price war following the abandonment of the trade's agreements after the Restrictive Trade Practices Act became law, has been to compel rationalisation steps to be taken.

Fewer Producers

This has meant that the method of separate factories, each with its own sales force, minor variations in product design and its own group of customers has had to be given up. In its place comes specialised mass production and large-scale distribution. Two companies are to cease production. They are the METROPOLITAN ELECTRIC CABLE AND CONSTRUCTION Company and the ST. HELENS CABLE AND RUBBER Company. Their output is being handled by other group factories.

Changed sales methods will reduce costs to the group by eliminating overlapping effort and improve the service to the customers.

The outstanding change in the cables themselves is the continuing swing away from rubber towards plastic materials. High speed extrusion and associated devices have been developed by BICC along with new methods of making joints.

W. T. GLOVER, a BICC subsidiary, pioneered the cross bonding technique and this has been accepted by the CENTRAL ELECTRICITY GENERATING BOARD as a way of achieving economies on schemes using large conductors. This technique was used in the largest super-tension cable order placed in the United Kingdom—the 125,000 yard, Belvedere to Sydenham (South-East London) 132 kilovolt gas-filled cable.

In telecommunications the associated company, SUBMARINE CABLES Limited, is to execute a £4 million order for the new cable between Canada and the UK. The deep sea section between the United Kingdom and Newfoundland is of drastically new design and will give 80 speech circuits. Intense international competition was defeated to obtain this contract. Between Newfoundland and Canada the cable runs beneath the St. Lawrence river, providing Canadian cities with a 120 speech circuit link.

At home a development that cheers the BICC prospect is the growing demand for floor heating cables, more and more buildings and houses being designed with heating from cables either buried in the floor or drawn into special ducts. Heating cables have also of course now come into use for ice and packed-snow prevention on roads and sports grounds.

Seeing the present year as full of opportunity, the BICC chairman recognises that it will be a difficult period, not least in the business of prices, particularly in the still disturbed area of low voltage mains and wiring and general cables.

£4 Million Issue by Metal Industries

METAL INDUSTRIES are to clear off the £3½ million overdraft left after their purchase of LANCASHIRE DYNAMO HOLDINGS.

That acquisition cost MI around £5½ million, of which £2 million was found from short term investments.

Provisional allotment letters have been sent out for a rights issue of 1,479,600 £1 Ordinary shares at 54*s* each. The issue is made possible by the increase in the authorised capital of Metal Industries from £10 million to £15 million.

The MI directors expect that the profits for the group in the year up to March 31, 1960, will reach £2½ million. This is including the profits of the Lancashire Dynamo group for the year 1959.

Guest Keen Start £6·75 Million Scheme

The IRON AND STEEL BOARD has sanctioned the further expansion scheme of the GUEST KEEN IRON & STEEL Company. At a cost of £6·75 million, just over half the £13 million invested in capital expenditure since 1946, the company is to step up its ingot steel output from 750,000 tons to 1,000,000.

The outline of the scheme is to bring the four blast furnaces at present operating with one as a standby into line with the current practice and enable all four to be blown simultaneously. This will lift the output of iron from 610,000 tons a year to 875,000, so keeping the iron works in phase with the steel melting shop.

By the introduction of a larger ingot and the extensive use of oxygen in the open hearth furnaces the production of ingot steel will then be brought up to a million tons a year.

£300,000 is to be spent on the most modern style of fume extraction plant for the control of dust and smoke.

For Cardiff, the South Wales port used by the Guest Keen works, the expansion by a quarter will mean more activity, both for port and railways. The company says that by 1963 when the scheme is completed it will need to enlarge its present 5,000 strong payroll.

Forecasting Machining Rates for 1970

An examination of the variables which control the removal of stock by machining shows that techniques have improved exponentially with a marked increase of rate since 1900. There is no sign of a levelling off.

WORKING on the theory that the past is a springboard into the future, the director of physical research of the Cincinnati Milling Machine Company of Cincinnati, Ohio, in a recent paper to the Society of Automotive Engineers, showed how one could probe ahead into what may happen to the stock removal process in the aircraft and guided missile business. Examination of the trends of improvement which have taken place in recent years gives some indication of what might happen in the future. Such a prediction process is necessarily crude and one does not expect everyone to agree on the specific values obtained from it. Nevertheless, the overall picture of the trends and the general conclusions which they imply may be much more definite.

The first step is to define the problems—to examine tomorrow's requirements and see what general, qualitative trends are associated with them. Improved versatility through automatic control, improved precision in the form of the ability to machine to closer tolerances, and improved productivity in the face of rising strength levels in the work material seem to be the main requirements and trends. The more quantitative trends which are associated with each of these three items are discussed in turn.

THE MACHINE TOOL

In the realm of versatility, Fig. 1 shows what has been happening in the way of improvement in automation of metal removal over the years. Beginning with power feed in 1820 through automatic programming in 1955 and automatic tooling in 1959, the trend of man-hour requirements has been steadily downward. Several features of this trend are interesting to note. Firstly, the trend appears exponential rather than linear, the graph being a log-log plot. Secondly, there has been an increased rate of improvement since 1900, and finally the rate of improvement shows no sign of levelling off—thus, there appears to be ample prospect of further improvement in this area in the next ten years. If the graph continues, the relative man-hour requirements for machining in 1970 will be half of those of today.

The second qualitative trend is that of closer tolerances. Wilkinson's boring machine in 1775 broke the first barrier. Prior to that, it was not possible to bore a cylinder with out of roundness less than about ¾ in. This proved to be an absolute barrier, for several years, to the realisation of Watt's steam engine. Wilkinson's machine, however, was true according to Watt's partner to within the thickness of a worn shilling. This trend is illustrated in Fig. 2. Again the rate of improvement has been exponential with time with an increased rate since 1900 such that, in recent years, the maximum attainable accuracy has increased by a factor of ten every ten years. While the graph shows no sign of levelling off, a strong physical limitation does lie ahead, namely the size of the atom. This corresponds roughly to one one-hundred millionth of an inch, and the trend suggests that this figure is being approached fairly rapidly. Whether one can go much beyond this point in machining is highly doubtful, so that an end-point may be met with here. However, should we ever finally attain the ability to machine to this accuracy, it seems unlikely that this limit can become a practical detriment to future manufacturing.

The third qualitative requirement is that of the need for improved productivity in the face of rising strength levels in the work material. This requirement shifts the attention away from the machine tool on to the metal removal process itself. It is to improvements in this area especially that we must look if we are to be able to machine the increasingly higher strength levels of work materials that may lie ahead.

Fig. 3 shows what has happened to airframe materials over the years and to the resulting permissible cutting speeds for machining these materials. Here again, the trends are exponential and, since 1920, the strength of the work material has increased by a factor of four. It is interesting to note that the four-fold increase in strength has only decreased the permissible cutting speed by a factor of two, as shown by the lowest curve in the graph. This particular curve corresponds to the cutting speed permissible for each of the different strength levels of materials at the time when the materials were introduced.

Of course, subsequent research has made it possible to increase these initial speeds as shown by the upper curve. Extrapolation of this upper curve shows that, if no improvement over today's machining technology took place within the next ten years, the permissible cutting speed would drop by another factor of two in that short period. On the other hand, even if machining technology continues to improve at the same rate as in the past, due to continuation of the present pattern of metal cutting research, permissible cutting speeds will still increase, even though less rapidly, as shown by the extrapolation of the "cutting speed when introduced" curve. Only if that curve can be made to change its trend and rise in the next ten years can actual improvement in productivity of airframe parts in machining be brought about.

TOOL MATERIAL AND GEOMETRY

Investigation of the trends and possibilities for such improvements in the machining process which will meet the challenge of these increasing strength levels draws attention to the cutting tool itself. What has happened as the result of improved tool materials is shown in Fig. 4. Once again, it can be seen that, whether the improvement is measured by the increase of the permissible cutting speed or the increase of the permissible strength level of the machineable work material, the rise over the years has been rapid and exponential. It appears that cutting speed is doubling every ten years due to the improvements in cutting tool materials. Although the curves show no sign of levelling off, a note of caution is sounded by these data. This is because the most recent points represent special cases, possible only under the most ideal con-

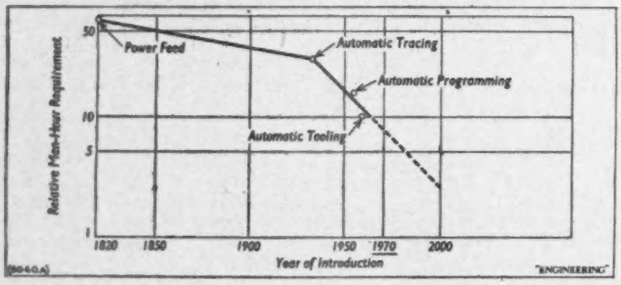


Fig. 1 The results of improvement in automation of metal removal over the years.

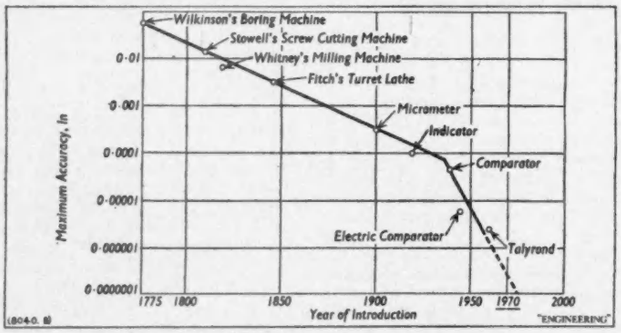


Fig. 2 The accuracy of machine tools plotted against time.

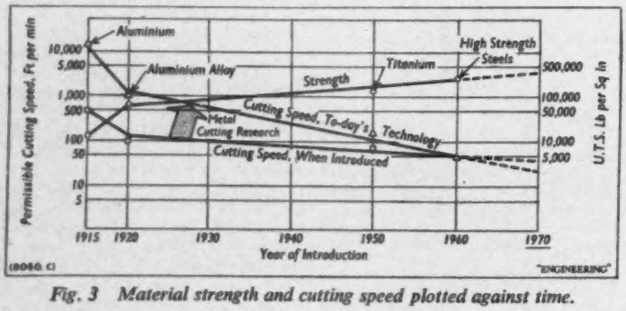


Fig. 3 Material strength and cutting speed plotted against time.

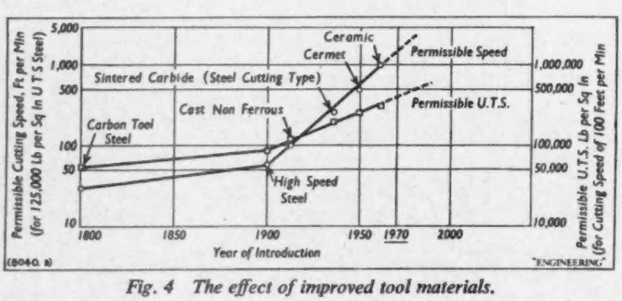
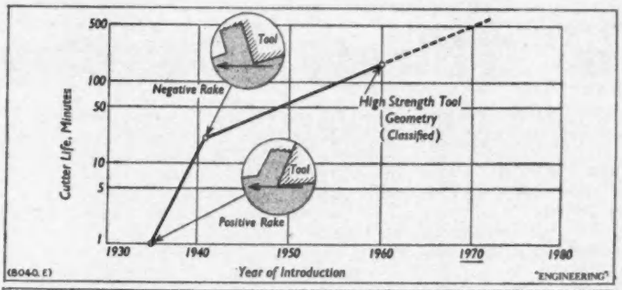
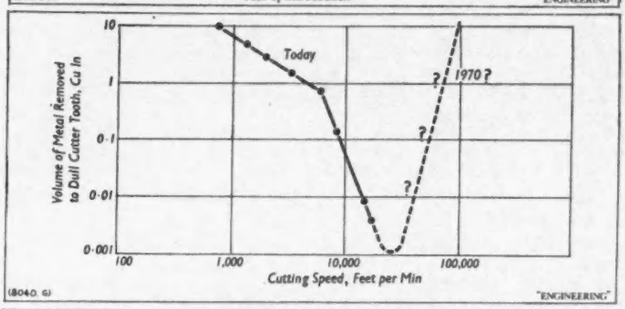


Fig. 4 The effect of improved tool materials.





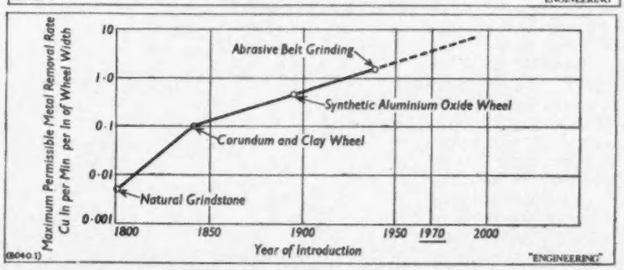

Maximum Permissible Metal Removal Rate Cu In per Min per In of Wheel Width
Abrasive Belt Grinding
Synthetic Aluminium Oxide Wheel
Corundum and Clay Wheel
Natural Grindstone
Year of Introduction
(8040. I)
"ENGINEERING"

Fig. 9 Grinding has improved at a rate of 40 per cent over ten years.

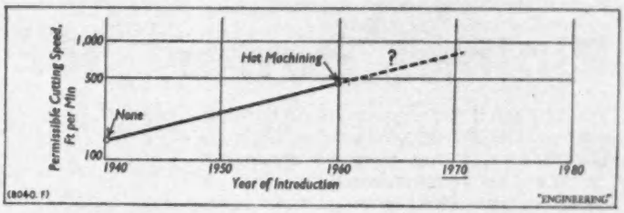


Fig. 5 (left) The effect of cutting tool geometry.

Fig. 6 (above) The effect of hot machining.

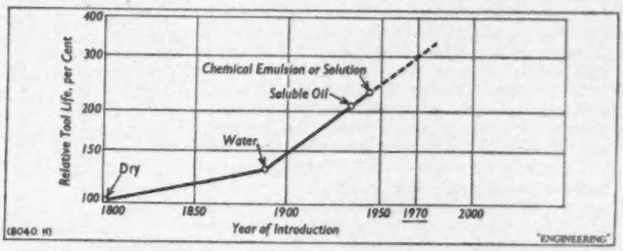


Fig. 7 (left) A guess at the effect of unconventional cutting speeds.

Fig. 8 (above) The effect of improved cutting fluids.

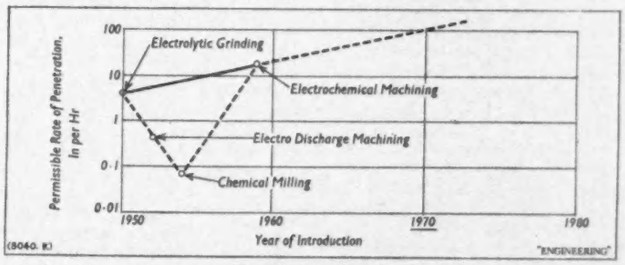


Fig. 10 Advances in electrical and chemical machining since their introduction.

ditions of freedom from vibration and freedom from impact during cutting. Thus, brittleness of the tool material is becoming the limiting factor and further research must concentrate very strongly on this aspect.

Changes in tool geometry can improve the performance on higher strength materials. Only in recent years has the importance of this aspect been fully realised. Fig. 5 presents an example of what has happened here—that of carbide milling. In this instance, the first major advance giving an improvement of tool life was the change over from positive to negative rake. More recent work by Cincinnati's produced the third point on the curve—details of which are not yet available. On this curve, there are only then three points which makes any extrapolation a very crude process. It does show though that cutter life has been tripled about every ten years through the medium of improving tool geometry. Thus we have another area which seems to have more potential available for improvement.

There is another line of attack which can lead to improvements in the workpiece itself. There is a possibility that the properties of the work material may be modified during machining. This is a new idea and is illustrated in Fig. 6, which shows the case of carbide milling of high strength steel. Because this is such a new idea there are only two points on the graph, which makes the case for extrapolation very thin indeed. The type of technique which has been used to provide the improvements shown here is that known as hot machining. This consists of locally heating the work material in a small zone ahead of the cutter, so that metal actually removed by the cutter tooth is much weaker than the parent metal. This method of modifying the work material properties has already permitted tripling of the cutting speed. This leads one to wonder whether there might be other methods for changing the work material properties, such as high frequency vibrations and the application of shock waves, which might lead to a similar improvement.

Another area of possible improvement is that which might be offered by the use of highly unconventional cutting conditions—the possibility of using cutting feeds and speeds far beyond the range of any of those currently employed in practice or tried in the laboratory. Here there are no previous improvements to serve as a basis for extrapolation. Take for example the possibility of high cutting speeds, far in excess of anything attempted. This possibility is illustrated in Fig. 7. Based on what happens up to the limits of today's speeds, about 15,000 ft per min, the trend would appear to be that tool life continues to decrease steadily with increased cutting speed. However, beyond that point no trend can be properly indicated: only a question can be asked—"Is there the possibility that this behaviour might reverse itself at very high speeds as indicated by the dotted lines?" This is a question of long standing, but one which is now hopefully to be answered by the Lockheed Aircraft Company and others in their investigations. Since there is no previous experience to use as a guide, only by actually experimenting with what happens with cutting speeds in the neighbourhood of 100,000 ft per min can one hope to prognosticate the possibiilities for 1970.

CUTTING FLUIDS AND GRINDING

Another possible area for improvement of the machining process, as such, is that of the use of cutting aids. As an example of the possibilities offered, the case of cutting fluids is illustrated in Fig. 8. Once again, the rate of improvement has been exponential and has been greater since 1900. However, even then, the rate of improvement has only been about 20 per cent every ten years, so that this area seems to hold the least potential for the next ten years of any examined so far in this article.

Returning to the machining process it is worth taking a look at the process of grinding. This is illustrated in Fig. 9. As in all the preceding cases, the rate of improvement over the years has been exponential in nature. Although this rate of improvement has been only about 40 per cent every ten years, there is no sign of it levelling off and so the rates of metal removal possible with this process are gradually approaching those permissible with conventional methods. Thus it seems possible that in the years ahead the grinding process may become less specialised in nature and more of a general purpose type of machining operation, with the consequent broadening in the versatility of machines built to carry out the grinding operation.

Turning from the conventional methods of machining and grinding used for stock removal, it is interesting to have a look at the possibilities offered by newer methods of taking off stock: electrical, chemical and physical. The various advances that have taken place in electrical and chemical methods of machining since their introduction are shown in Fig. 10. Taken as a whole, these methods show no well defined trend at the present time. The newer process of chemical milling and electron beam machining actually show a decreased rate of penetration over that obtainable with electrolytic grinding. Of course, other features of these processes, such as their ability to work on very high strength level materials, more than offset this low rate of penetration presently experienced. However, the most recent advance in this field, that of electro-chemical or electrolytic machining does show significant improvement. This process may be viewed as either an electrical aid to chemical milling or a simplification of the electrolytic grinding, and either way it shows a significant improvement in metal removal rate. Even if one views electro-chemical machining as a simplification of the electrolytic grinding process, one sees that there has been a fourfold improvement in rate of penetration in the past ten years. It is not unreasonable to suppose that methods such as this hold possibilities of at least that much additional improvement in the next ten years, perhaps far more, with their excellent ability to work on materials of very high strength.

Piping Power for a Thirsty Country

Water and power consumption rise with the standard of living. Both can be piped to remote areas, and combination in a single pipeline would result in important economies.

COMMUNITIES have lower mobility than commodities. As a result, energy and products have to be transported over long distances—a problem that tends to be aggravated as the standard of living improves. Urbanisation away from the primary energy sources, increased power consumption per capita, and a growing population strain the available transfer facilities and serve as incentive in the search for better methods.

Experience has shown that the discovery of natural resources has little affect on people's appreciation of a piece of land. No great population shifts followed the discovery of oil in the Middle East, in Venezuela, in Texas, or in Western Canada; and the coalfields of England are being deserted while the population crowds into energy deficient areas. The magnitude of the problem is illustrated in Fig. 1, showing the flow of energy forecast for the year 1964-5 in the areas of the Central Electricity Generating Board.

Location of the primary energy sources and the centres of consumption serve as end-points to a chain of fixed length, which can be made up of a great variety of links. Taking the example of coal, which will provide about 80 per cent of Britain's energy even in 1965, the elementary components of the transmission chain are illustrated in Fig. 2. Within certain economic and practical limits the length of each link is variable, and provides an important opportunity to the designer for improving transmission economics.

The choice of links in Fig. 2 is quite typical of conditions found in the United Kingdom. Considerable latitude exists even in such a simple transmission chain in the selection of individual components. Barge transport might replace the railway line between mine and boiler plant; or a pumped storage energy loop may be interposed between the electrical generator and the final high tension transmission line. In the United States a typical chain might start at an oilfield, and include a collecting pipeline, a refinery, and a distribution system of pipelines or tankers before the steam generating plant is reached. A power cycle using nuclear fuel is even more complex, involving several stages of fuel refinement and fabrication between mine and plant.

Transmission of potential or mechanical energy in general involves heavy losses and the transmission length has to be kept to a minimum. The steam raising plant, the turbines and the electrical generating equipment are usually placed on a single site, leaving only variations in the method and length of fuel and electrical transmission at the designer's disposal. Both these aspects of energy transmission received attention at the World Power Conference, just completed in Madrid, with a special session devoted to each.

TO TRANSPORT FUEL OR ELECTRICITY

Whether to site a power station near the point of consumption or the point of primary production is the classical power engineering problem. Often the problem is complicated by the lack of suitable sites or cooling water, the influence of aesthetic pressure groups, and considerations of military vulnerability. A case of straight economics unhampered by extraneous influences is now under consideration in Trinidad.

The centre of electricity consumption is in the Port of Spain area at the northern tip of the island, while natural gas fields occur around Penal about 40 miles to the south. The choice of energy transmission is between gas pipe and high-tension electrical lines. A study by W. N. Foster and K. W. Finch (paper III/I) showed that under the conditions found in Trinidad (75 per cent load factor, 25 per cent efficiency) the two methods are highly competitive when the energy transmission exceeds 40 MW; with gas transmission showing a slight advantage when the power transmitted exceeds 75 MW.

But the authors make the important conclusion that while an electrical transmission line will be a single purpose installation—to transmit high-grade (electrical) energy—a gas pipeline can be used to transmit both high grade and low grade energy. If customers could be found for natural gas in the Port of Spain area in addition to the electricity producers, the economical balance would swing decidedly in favour of pipeline transmission. The question then arises whether further economies could not be attained by using pipelines to transport a diversity of products.

MULTIPURPOSE PIPELINES

Flexible pipeline operation is only now beginning to become an economic factor. Even without any special barrier devices, American experience has shown that dissimilar products can be pumped through a pipe without appreciable mixing. A single pipe grid in a refinery serves to move most light products between tank farm and loading stations, and only a small amount has to be degraded to the lower quality fraction when the stream is changed. More recently rubber balls have been used with success to serve as barriers between incompatible liquids. In this way epoxy resins have been carried along pipelines between two rubber balls in order to apply a new coating to the inside of the pipe. (see Continuous Transport of Fuel by Pipe, ENGNG., 27 May, '60, p. 719.)

Such developments are of extreme importance to pipeline economics. All processes characterised by high capital and low operating cost require the fullest utilisation in order to be economical. A very large proportion of a pipeline's cost is invested in site surveys, clearance, acquisition of rights of way, and the maintenance of construction crews in remote and mobile camps. All these factors are almost independent of pipe diameter. For low cost, it is essential that the greatest number of the largest practical pipe should be laid in one run.

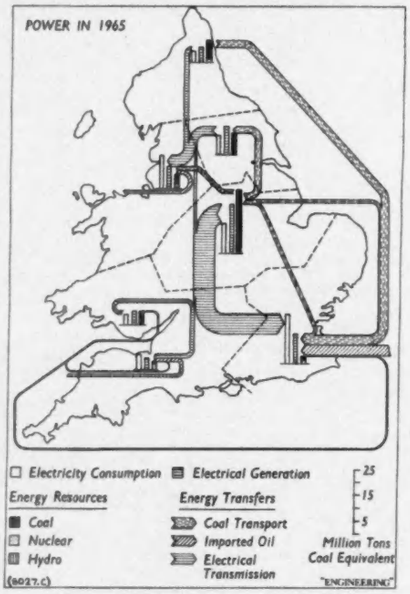


Fig. 1 Forecast of energy flow for the year 1965.

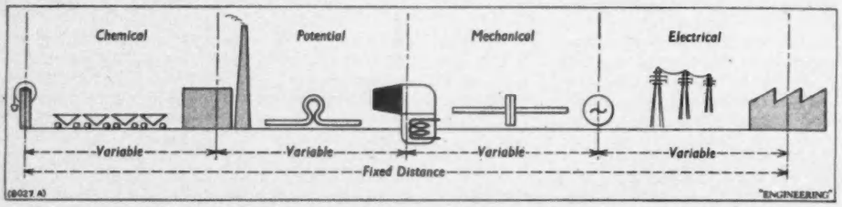


Fig. 2 The end-points of a transmission chain are fixed, but the length of each link is variable.

Multipurpose operation would completely revise pipeline economics, producing a marked similarity to railway operation. The high capital investment in railways is only justified because of the flexibility in operation; whereas pipelines have so far tended to rely on a single product and a single group of customers. As a result, only a few products involving the transfer of large volumes of bulk fluids have justified the installation: hydrocarbons and water.

Energy and water are the substance of civilisation. There is a very definite relationship between the standard of living, energy consumption and water consumption; both in time and in space. The estimated increase in water consumption in the 10 year period between 1955-65 will be 25 per cent, in power consumption 75 per cent, a ratio of 1 to 3. The spatial relationship between water and power consumption can be seen by comparing Fig. 1 and Fig. 3, the latter based on the report of the Central Advisory Water Committee, 1959. Energy transfer in the United Kingdom is solved by means of electrical transmission and rail and barge transport of coal. Water transfer—so far not critical except in unusually dry years—is as yet unsolved.

A national water grid to combat periodic shortages in England is advocated after each dry year. But the technical difficulties which arise from mixing waters of dissimilar pH value, the high capital cost of pipelines, and lack of centralised authority have prevented action. In view of the well developed electrical grid available in this country, it is unlikely that water and energy transport will ever be linked in a pipeline project, while the flow of liquid hydrocarbons is still too small to make much of an impact.

But other countries have different problems. As the population of the world increases, arid sections will become increasingly populated. Given an adequate supply of water and power, desert climates such as in Arizona and Texas, can be turned into enviable living conditions. Extrapolating one step further, with an even larger source of piped water, these territories can be turned into important sources of food. Water and power go hand in hand in such projects, but while power can be transported in many forms *including* pipes, water can only be transported in canals or pipes.

The principal energy sources of the future will be coal, liquid hydrocarbons, natural gas, and hydraulic and nuclear energy. Distribution piping for liquid hydrocarbons and natural gas is already used extensively but the transport of untreated water using the same piping system is a possibility that has not yet received much attention. It may or may not be possible to use water contaminated by refinery products for irrigation and industrial purposes. If contamina-

tion is not objectionable, the pipelines could be used both for water and energy transport.

If energy is generated using natural gas, the transport possibilities are simultaneous two-phase flow, requiring a constant gradient in the pipe and gas compressing equipment; or intermittent operation using rubber balls to separate the liquid from the gas. In the latter case the storage capacity at the point of use would have to be considerably larger than required by simultaneous gas-liquid flow, and would also require separate pumps and compressors.

Coal lends itself quite well to transportation by pipeline using water as carrier, and experimental systems are in operation at the British Hydromechanics Research Association and the Woodend Colliery. A full-scale power station using hydraulically pumped coal fines is in operation in the Loire coal mining area. Of the numerous variants possible, the arrangement shown in Fig. 4 lends itself best to the simultaneous transport of coal and water.

As the pump operates only on clear water, the system is suitable for the transport of ungraded relatively coarse coal particles. Assuming a minimum water-to-coal ratio of 2 to 1, a 100 MW transmission system, typical of a town of 200,000 people, using 80 per cent load factor and 25 per cent thermal efficiency would deliver approximately 100 million gallons of water per year, or the domestic requirement of an urban population of 10,000 persons. The water-to-coal ratio can of course be increased as required above the minimum of 2 to 1.

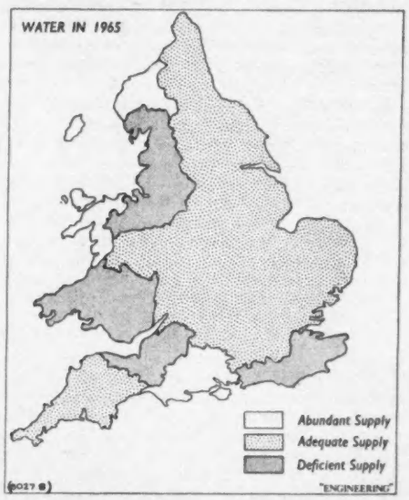


Fig. 3 (left) Forecast of water resources for the year 1965, assuming average rainfall.

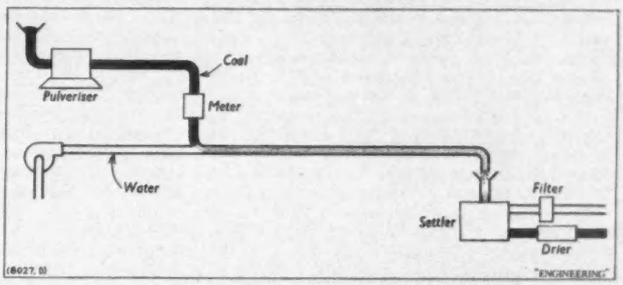


Fig. 4 (right) Scheme for piping water for irrigation, and coal for power through the same pipeline.

Hydroelectric power will continue to be one of the cheapest sources available, particularly in multi-purpose storage and regulation schemes linked with the water supply of an area. At the moment the only practical method to transport water power over long distances is by electrical transmission.

But looking into the not too distant future even hydro-electricity can be linked with pipeline transmission. It can be assumed that power is generated at a storage reservoir, and that large pipelines are in existence to supply water to a population and industrial centre. It has often been suggested that with successful development of fuel cells, off peak energy could be stored in the form of electrolysed water, and recombined when required. Since the existence of a large water pipe-line is already assumed, the added cost of electrical transmission can be eliminated if it is found possible to pass the dissociated oxygen and hydrogen through the pipeline.

Approximately 7 cu. ft of hydrogen and 3·5 cu. ft of oxygen are dissociated for each kWh of energy. Thus the energy transported per cubic foot of dissociated water is approximately 330 Btu, as opposed to 1,000 Btu for a typical natural gas. But the availability of the energy contained is much higher. For a fuel cell a reconversion efficiency of 80 per cent may be assumed (Practical Fuel Cell Gives Electric power, ENGINEERING, p. 106, vol. 188, 28 August, 1959), while the conversion efficiency of natural gas will only be around 30 per cent. Thus the net energy transported by dissociated water and natural gas is 260 and 300 Btu per cubic foot respectively.

Returning to the Trinidad example, it is found economical to transport energy in the form of 300 Btu (net) natural gas over a distance of 40 miles provided the capacity exceeds 75 MW. Only a small increase is required to make the operation economical on gas that has a net energy transport of 260 Btu.

STORAGE AND TRANSMISSION

The feasibility of the scheme then depends on the capital cost of the fuel cell conversion plant, and whether it is feasible to transport water and hydrogen, or water and oxygen in the same pipe. The solubility of hydrogen and oxygen in water is relatively low—between 0·02 and 0·05 cu. ft per cu. ft of water—so that the losses from mixed flow may be acceptable. The dissociated gas would contribute about 3,000 gallons per hour upon recombination to the flow of water, assuming a 100 MW installation.

It is obvious that a 40 mile transmission line is too short to make such a scheme attractive. The cost of a 132 kV installation is only £600,000 for the 40 mile distance, and assuming that pipe transmission would save the whole amount, the cost of reconversion equipment would have to be less than £6 per installed kilowatt to be competitive. As steam generating plant costs are nearer to £40 per installed kilowatt, it is obvious that piped hydraulic energy cannot be applied with any hope of success where the transmission distance is short. Whether water will ever be piped over longer distances is open to question.

The feature that removes the fuel cell scheme from the realm of pure fantasy is the ability to store gas in a pipeline. Dr. Albert Fono presented a paper to the World Power Conference on means of improving the economy and safety of long distance gas pipelines (paper IIIA/7). In his scheme the pressure of natural gas would be raised to a higher level at the inlet end, and the power input recovered through gas turbines at the outlet end. Actually more useful work is obtained from the turbines than put in through the first pump because natural gas often leaves the well-head at a high pressure and the turbine would operate between well-head pressure and near-atmospheric distribution pressure.

Dr. Fono points out that an incidental advantage of his proposal is the ability to store sufficient gas in the pipeline to maintain continuous delivery with discontinuous feed. Repairs could be made to sections of the pipeline or the compressors without any interruption in the service.

The storage capacity of the water-gas pipes could be used either to improve the load factor of the electrical generating equipment, or deliveries could be scheduled in such a way that larger quantities of water are pumped during off-peak periods. Adding energy storage to energy transmission, the scheme may well become economical.

Returning from an exploration of the future to more solid ground, the important conclusion is that pipes have the unique ability to transfer large quantities of bulk fluids—liquids, gases, or fluidised suspensions—over long distances economically, provided that two conditions are observed: the capacity must be high and the utilisation nearly 100 per cent.

These conditions are encountered in many more instances if the transmission of dissimilar products is considered in the same pipeline: water, hydrocarbons, energy, and many others. The day may not be far off when a great variety of finished products encapsulated in disposable or reusable spherical containers will be pumped along with primary products. A pipeline grid then will combine its ability for continuous bulk transport with the versatility of road and rail.

Such developments will be necessary because although our production is specialised, our consumption is not, and will be spread over larger and larger areas of the world. Only a system capable of full automation can provide a satisfactory solution, and pipelines can be controlled with the minimum of attention.

Diesel Railway Breakdown Cranes

Railway breakdown cranes have always been steam driven, but new ground is broken by some of a batch of 22 cranes ordered by British Railways from Cowans, Sheldon and Company Limited, Carlisle. Four of the cranes, two of 75 tons and two of 30 tons capacity, are diesel powered with hydraulic transmission; they are the first of their type to be built for use in Great Britain. Twelve of the batch are of a new 75 ton type for use on main lines; the remainder, which can lift up to 30 tons, are designed for use on both main and branch lines.

All the cranes are of the self-propelled type, able to move at slow speeds under their own power, and can lift, slew and derrick. They have separate haulage winches for dragging aside debris, and the 75 ton type has an auxiliar hoist for lifts of up to 10 tons. Outriggers and jacks are provided for lifting heavy loads or working at extended radii. To enable them to be hauled between locations in train formation at speeds up to 60 m.p.h., roller bearing axleboxes are fitted. With a total weight of about 120 tons the 75 ton crane will lift its maximum load at 18 ft radius when blocked up. With the crane free on the rails, 12 tons can be lifted at 18 ft. The 30 ton model has a weight of about 65 tons, and when blocked up will lift its maximum load at 16 ft radius; 10 tons at the same radius is the free lifting capacity.

Power is supplied, on the 75 ton diesel model, by a Rolls-Royce four cylinder vertical supercharged engine rated at 149 b.h.p. at 1,500 r.p.m. On the 30 ton diesel crane the engine is a Rolls-Royce of similar type, but rated at 119 b.h.p. at 1,500 r.p.m. In both cases the drive is taken through Rolls-Royce Hydrokenetic three stage torque converters. Separate diesel generators provide power for floodlights and power tools.

On the Shelf

By Frank H. Smith

HAD a letter the other day from a man in America who reads this lot and he asked if I could help him with delivery of English books. It seems that when he orders something he's read about here, it takes about 12 weeks to get it through an American bookseller. What he wants to do, therefore, is to arrange with a London bookseller to send the stuff out airmail and cut that 12 weeks down to one or thereabouts. When I rang an agent what I wot he said "That's quite understandable. I've heard of cases where American firms have ordered American books through an English house in order to get them more quickly." Wodya Know?

If I mention an American publisher perhaps an English agent will come to light for Interlanguage Dictionaries Publishing Corp., of 227 West 17th Street, New York 11, who do eight dollars worth of *German-English Mathematics Dictionary*. They invite you to order it on approval but I doubt if this applies to transatlantic privilege.

America seems to be a little concerned (as we are) at the standard of technical writing, and Volume I of *Writing in Industry* is advertised by the Plenum Press of 227 West 17th Street, New York 11, at $2·75. This book is made up of papers from a conference on writing and publication in industry held at the Brooklyn Polytechnic Institute last year and your bookseller should remember who the Plenum agents are in this country—it's Chapman 'n' 'all.

The house magazine cum new book lists of Dent's (J. M. Dent and Sons Limited, Bedford Street, London, WC2—London's distinguished street) which is called *Everyman*, has innovated a buff inserted supplement which lists the new books of themselves and Phoenix House and the Galley Press—but not the Everyman series. To get *Everyman* regularly send 2*s* to cover postage and recording for two years.

A useful current paper of the Aeronautical Research Council (No. 444, price 2*s* 6*d*, HMSO) has the long-winded title "List of the Journals and Periodicals to which reference is made in Incompressible Aerodynamics and Laminar Boundary Layers together with their Abbreviations," and I have a feeling that two prepositions have got transposed.

On 8 January I referred to some well-chosen words by Reading's Professor Cormack on the subject of Librarymanship. The whole text (and some other good stuff besides) now appears in the *Report of Proceedings of Home Universities Conference, 1959*, 5*s*, from the Association of Universities of the British Commonwealth, 36 Gordon Square, London, WC1.

The Electronic Engineering Association is anxious that their annual review (a very handsome bit of work) should be seen by all to whom it is of interest and use. Drop, therefore, a postcard to 11 Green Street, London, W1, and get some idea of the fields covered by those wizards of the valve, the circuit and the semi-conductor.

The City and Guilds of London Institute (70 Portland Place, London, W1) have issued a leaflet about the 1960 International Apprentice Competition. This year it is in Spain, where it started in 1947. The competition has grown from a purely domestic (Iberian) affair. But last year this country alone sent 23 lads (1 in 1955, 6 in 1956, 12 in 1957, 21 in 1958 and 23 in 1959). Any firm sending an entrant is required to pay travelling only (and a spot of pocket money I hope) and, whether the lad wins or not, the travel should pay dividends in character development. There are two age categories ranging from 1939 to 1944 and a choice of trades. Full particulars from the address given, but get to work all you Apprentice Supervisors and Works Managers. (I don't care how I talk to 'em, do I?)

Waves, Currents, Breakwaters, Jetties

Dock and Harbour Engineering. Volume 2: The Design of Harbours. By H. F. CORNICK. *Charles Griffin.* (126*s*)

In the review of Volume 1 of Mr. Cornick's four-volume treatise (ENGNG., vol. 185, '58, p. 762) reference was made to the encyclopaedic range of the work. In Volume 2, which has now been published, the same comprehensive and intensive treatment is maintained. This volume of 344 demi-quarto pages and containing over 300 illustrations deals with harbour design, tides and waves, surveying, breakwaters, jetties and piers, entrance channels and channel demarcation and moorings. As in Volume 1, there is an extensive bibliography at the end of each chapter and the range and catholicity of Mr. Cornick's reading and research are evidenced by the fact that the references in this volume alone number over 170.

After a short introductory section dealing mainly with the historical background of harbours, the volume opens with a consideration of harbour design generally, and factors such as the effects of tides, winds, coastal changes, littoral drift and wave action are discussed. The basic requirements of a harbour are enumerated and described and ways in which these are provided are amply illustrated.

In the next chapter Mr. Cornick plunges into an exegesis of the phenomena of tides and waves. In these subjects, currents or empiricism vie with surges of pure mathematics and provide dangerous whirlpools for the unwary which the author is at pains to point out. The reader is given a review of the various phenomena, the theoretical explanations for their occurrence and their practical implications for the engineer. After a short section on tides, there follows a survey on waves which includes discussions on seiches, ranging and storm surges. It would be impossible to deal in any way exhaustively with these involved and sometimes contentious subjects in the space available, but the comprehensive bibliography provided will assist those who wish to extend their reading in this sphere, and indeed this chapter would serve as an excellent introduction to a detailed study of these baffling but fascinating phenomena.

There follows a chapter on marine surveying in which the general principles are briefly stated and descriptions are given of the methods and equipment used for surveying, sounding, measuring currents, silt sampling and so on. In the opening section the author states "In the space at our disposal it is not possible to enter into a detailed explanation of the principles underlying the carrying out of a complete hydrographical survey and we must confine ourselves to describing in brief outline the main operations . . ." yet almost immediately following is a description of an instrument (one of many used in this work) which is lengthier than the section devoted to the basic principles of harbour surveying and there are detailed descriptions of other instruments and tackle which could easily be found in manufacturers' literature.

The next chapter on "breakwaters and pierheads" is a study of the highest order in its comprehensive treatment of design theory, its copious illustrations and its descriptions of a large number of actual works. Of particular interest and value are the discussions of failures, their causes and subsequent remedial action. In this chapter Mr. Cornick gives the reader a vivid impression of the mighty forces of nature which the maritime engineer must strive to bend to the service of man. If a criticism is to be made, it must be levied at the inclusion in the chapter of passages such as "It is desirable to examine the breakwater site by borings or probings and from the information gained to estimate the bearing capacity of the substratum. . . ." One feels that the reader who can benefit from a study of this chapter which deals with major works and complex and often subtle empirical design considerations will inevitably bring to his reading a background of knowledge and experience which renders such a comment unnecessary. This and similar passages (for example, an elementary treatment of shear, sliding and overturning in masonry blocks) are no doubt included because the author is considering the student engineer, whereas a work of this size and scope is surely more properly to be addressed to engineers with a considerable degree of maturity.

Jetties, piers and landing stages which are the subjects of the next chapter are handled with that comprehensive sweep which characterises the author's work. In one illustration alone, 16 different types of jetty construction are shown. The clarity and detail of this illustration as indeed of all illustrations in this publication, are a credit to all concerned. A significant omission, however, is a consideration of dolphins. These are of great importance particularly in connection with oil tanker berths and many important developments have occurred in recent years, among them the use of torsion systems to absorb impact and of large-diameter steel tubular piles.

In discussing different structural media Mr. Cornick claims that the braced type of reinforced concrete jetty has a much great degree of durability than its counterpart in timber. He also maintains that the use of timber piles represents the weakest form of jetty construction owing to, as he states, its low energy absorbing capacity, although its flexibility is remarkable, allowing it to absorb heavy blows. He also states that elastic deformation must be reduced as much as possible if the structure is of reinforced concrete or steel or timber.

One cannot agree with these views. Recent design studies and full-scale tests which the Port of London Authority have carried out indicate quite clearly that provided a degree of flexibility can be permitted (as in lead-in jetties) timber structures suitably designed are by far the most economical from the point of view of energy absorption. Indeed, greenheart in bending has the highest strength-cost ratio of all commonly available structural materials. Jetties with greenheart piles (which are by no means weak) used virtually as cantilevers and with their decks designed as strong horizontal girders have extremely high energy-absorption capacities and, provided careful attention is given to the design of connections, they are extremely durable. On the other hand, the extensive repairs that have had to be carried out to reinforced concrete jetties all over the world in recent years have dispelled early claims as to the durability of this medium—although it is hoped that the greater knowledge of concrete mix design and of control techniques that is now evident will reinstate the faith that has been held in the potential of reinforced concrete as a suitable maritime structural medium.

This chapter devotes some 15 pages to the bearing power of piles and deals with the elementary theory of momentum at some length. These passages are presumably addressed to the student reader but as the information is readily available in standard textbooks they could well have been omitted from a work of this nature.

There follows a review of entrance channels, and here the author's experience as one-time river engineer of the Port of London Authority, his wide knowledge of estuaries throughout the world and his thorough acquaintance with the research literature combine to make this chapter one of the greatest value. The delicate factors governing estuarine regime, the control of which is so vital to the majority of the world's large ports, demand wide experience allied to a deep understanding of salinity gradients, siltation and current formation if their control is to be successful and many ports know to their cost the calamitous results of apparently insignificant modifications to regime conditions. Mr. Cornick gives a clear picture of the complex

factors that must be studied and understood and his contribution forms an excellent basis for wider reading in this subject.

The final chapter deals with channel demarcation and moorings and is characterised once more by its exhaustive treatment and excellent illustrations.

Volume 2 of *Dock and Harbour Engineering* is like Volume 1, a remarkable *tour de force* and a valuable reference work for practising maritime engineers.

N. N. B. ORDMAN

Inside the Soviet Nuclear Bureaucracy

Atomic Energy in the Soviet Union. By ARNOLD KRAMISH. *Stanford University Press, Stanford, California; Oxford University Press, London.* (27*s* 6*d*)

There are two points of view from which this book can be considered. On the one hand it is a useful guide to the present structure of the Soviet atomic energy industry and on the other it is a thoughtful account of the industry's development from its earliest days to the present time. Allowing for the fact that the author has had to assemble his information from published sources alone, and that these are, in places, somewhat sparse, the book is a notable achievement. Starting from this uneven material it succeeds in being both informative and readable.

It is in no sense a technical work. It reports the interaction between a certain kind of government administrative machine and a new technology which has been developing at very high speed. In consequence it will appeal both to the layman and to the engineer, for it is at the same time the history of the vicissitudes of the atomic industry in one country (and what atomic industry anywhere has not had to sufier the direct interference of bureaucracy?) and a comment on the way in which industry, political philosophy and political administration act upon one another. The book has a further claim to lay and technical attention: it clears away much contentious rubbish which even the reasonably well-informed have all too often accepted.

In places the author has interpolated his own deductions from the available evidence, but this adds to the value of the book. It is clera where this has been done and the technically knowledgable may readily distinguish between fact and opinion if they wish to do so.

Rather than give a synopsis of its contents, it is perhaps more useful to touch upon a number of scattered topics covered in the book, so indicating the nature of the subject matter and the quality of its thought. Throughout, the reportage is taken to be accurate.

There is no doubt, according to the book, that Russian physicists made useful and original contributions to the development of the theory and application of nuclear fission. The widely held lay view that Russia came very late into the field and caught up by making off with captive German scientists after the last war is crude and completely inaccurate. Nevertheless, the Russians suffered from a major handicap, which hampered scientific inquiry several times between 1920 and 1955, namely, the need to keep nuclear research related to some immediately practical end. Communist theory and political control have repeatedly dealt severely with "pure" research in all fields, and though today such research is seen to yield attractive and often unexpected fruits, the practical terms of reference have merely been broadened, not discarded. But now that the tools of scientific research have become so costly, the same condition applies increasingly in the West.

Soviet scientists have also been presented with a further obstacle—the requirement that scientific hypothesis shall tally with the dielectical materialism of Marx and Engels. Some basic research and its interpretation in scientific terms may have been feasible under the none-too-vigilant eye of the People's Commissariat of Heavy Industry in the 1930's, but later, when atomic energy fell under the control of Beria's police, presumably for security reasons, it was a different matter. Nevertheless it was a far-seeing official eye that recognised the potential practical benets of building large and costly particle accelerators.

Difficult as it may have been to pursue purely academic work, the author points out that the first discovery of spontaneous fission was made by Petrzhak and Flerov in May, 1939, and that "their work showed an ingenuity and meticulousness usually expected from a fine Western laboratory." No doubt it is not beyond tbe wit of Soviet physicists—any more than of their Western colleagues—to prise funds from their careful masters by hinting at the practical possibilities of even the most fundamental studies.

After such an excellent start why did the Russians take the wrong direction, following the German invasion? In one of the best sections of the book the author seeks to marshal the facts and interpret them. He gives full weight to the stern decision the Soviet authorities had to make in postponing everything which did not immediately contribute to the war effort. Yet the evidence strongly suggests that they seriously underestimated the possibilities of atomic energy applied to military uses and that they were too reverential in their opinion of German nuclear research. The Germans were pessimistic about the prospect of developing a bomb even after the Anglo-American project was in hand. One is tempted to think that the Russian love of "practical" scientific work fitted the needs of their country's situation just a little too easily. Atomic research was not resumed after the invasion until the autumn of 1943.

When the nuclear programme was revived it went through a somewhat casual period. There are several interesting pages about the ineptitude and indifference of Russian intelligence work at the top following the espionage activities of Fuchs and the Canadian ring.

On balance it would seem that the Russian political administrators made a series of major blunders about atomic energy even when allowance is made for the agonising decisions they had to make before Stalingrad. Indeed, the book is indirectly a plea against the stifling of scientific work by political control. In the end democracy got the bomb and authoritarianism missed it.

Since the war, especially since the end of Stalin's obsession with secrecy, the Soviet programme has been impressive in scope and results. The Russians have not hesitated to copy the West where necessary but they have performed good original work and, despite the tradition of secrecy, they have apparently learned the value of publicising within Russia, and often elsewhere, scienfic developments which appear to offer only the remotest chance of application, in the often fruitful hope that someone somewhere may find a use for them.

But even in the last few years nuclear activity has not been unaffected by propaganda. Russian information on isotopes has been published to emphasise the peaceful trend of Russian efforts, but apart from Academician Kurchatov's dramatic lecture at Harwell in 1956 (ENGINEERING, vol. 181, p. 322) and Academician Artsimovich's modest account at Geneva in 1958 of Soviet fusion work (ENGINEERING, vol, 186, pp. 400, 796 and 824), few details of thermonuclear experiments are available. Much general information has been released about Russian power stations and the nuclear-powered icebreaker Lenin, but less about the practical solutions of real technical problems.

The book ends with a useful account of present research organisation and a good index.

G. E. TEWSON

Work Without Bosses?

A New Approach to Industrial Democracy. By H. A. CLEGG. *The Congress for Cultural Freedom, 104 boulevard Haussmann, Paris 8; Basil Blackwell, Oxford.* (18*s* 6*d*)

The dream of work without bosses has formed one of the sources of inspiration of the Socialist movement since the days of Bakunin. It was, however, an anarchist conception and, as such, has had little influence in the trade union movement except in countries, such as France and Spain, where the unions remained weak and sectarian. On a more practical level there have been many suggestions for associating the worker with his own management, ranging from the elaborate representative arrangements of the Guild Socialists to mild proposals for a director elected by the workers to a company board.

The practice in different countries varies greatly from the workers councils which manage all undertakings in Yugoslavia and the participation of worker representatives in the supervisory boards of German industry, under the law of "co-determination," to the merely advisory functions of our own joint production committees.

How far do these arrangements fulfil the demand for "industrial democracy"? It was to this question that a conference organised in Vienna in 1958 by the Committee for Cultural Freedom devoted itself, from which Mr. Clegg has written this excellent essay. He starts with the theory that there are three principles determining the role of trade unions in industry which govern their behaviour in advanced industrial countries. These parallel the modern theory of political democracy as a system, not by which people govern themselves, but of interest groups which force government to recognise every claim and grievance and ensure individual liberties. The three principles are the independence of the trade unions, the sole representation of the industrial interests of the workers by the trade unions and the irrelevance of the ownership of industry to good industrial relations.

Having examined the practices in a number of countries Mr. Clegg is able to restate these principles so as to take account of the differing experiences and political backgrounds from which they grow; and, in the process, demonstrates that some views firmly held by the British trade unions are not necessarily soundly based.

Little is left of the early ideas of self-government in industry through sharing in management. Industrial democracy turns out to be the protec-

Continued on next page

tion of the workers' rights by pressure groups. All that might be found among the complexities of modern industry are some areas where management is unnecessary and one such example, from a coal mine, is given. Here a team of miners jointly undertook the responsibility of providing and manning work groups on each of three shifts. Somewhat similar arrangements sometimes operate in industry under group bonus systems. Although the unions may be suspicious of a system which recalls the days of the labour subcontract and the " butty," there may well be a number of situations where, under modern conditions, the idea of transferring a defined set of functions from management to a group of workers might be tried.

AUSTEN ALBU

Coordinates of Human Knowledge

Guide to Reference Material. Edited by A. J. WALFORD. *The Library Association.* (80*s*)

Will Rogers has enunciated the important scientific principle that " the trouble today ain't the people that don't know enough, but the people that know too much that ain't so." This is merely a restatement of the fact that human memory is unreliable, particularly when affected by personal preferences and the increasing growth of technical complexity.

Today it is axiomatic that nobody can know it all. Indeed, the " Johnnie know-all " is today a social outcast, and is replaced by the Man Who Knows How and Where to Find It. These new circumstances call for two main expedients: reference books and indexing systems. The compilation of the former, and the invention of the latter have become highly specialised professions.

In the recent publication under review, both expedients are admirably combined though perhaps not to the degree of perfection that the idealist might wish. The book is a classified catalogue of reference books from many countries covering practically the whole field of human knowledge, but an attempt to cover such a huge field in a volume of 543 pages cannot be very detailed. Indeed, the references, particularly in the technical and scientific fields, are somewhat scanty. For instance, Welding and Marine Engineering are each given only one reference.

The entries are classified on the basis of the Universal Decimal and Dewey Decimal Systems, which have a wide acceptance in libraries throughout the world, and in addition there is a comprehensive alphabetical index.

These decimal systems, notwithstanding their vogue, are not the only, nor indeed in some opinions, the best suited for the retrieval of information. They are based primarily on the idea of allotting a definite and unique pigeonhole to each unit of data (book, paper, report, etc.) and retrieval is based on knowing the right pigeonhole in which the required data can be found. With the increasing complexity of knowledge, the number of pigeonholes tends to multiply astronomically, and retrieval becomes increasingly difficult. Cross-indexing under the Decimal Systems is a subsidiary consideration, which adds to the bulk without important gains.

A more modern approach, which is gaining popularity, is the principle of " feature indexing," under which retrieval is accomplished by seeking all the items which have certain features in common. This can be done by a simple, manually operated punched card system.

The book will be useful to librarians who are building up or reviewing their reference sections, but will have little appeal to the general reader or seeker after knowledge.

G. M. BOYD

New Books

The Marine Corrosion Handbook. By T. HOWARD ROGERS. *McGraw-Hill Company of Canada, Toronto and London.* (97*s*)

Originating from a request for a handbook for the use of Royal Canadian Navy personnel, this book will be of value in the whole field of marine engineering, drawing as it does upon the research experience of the RCN Dockyard Laboratory at Halifax, Nova Scotia.

Concrete Formwork Designer's Handbook. By H. R. GILL. *Concrete Publications Limited, 14 Dartmouth Street, London, SW1.* (15*s*)

The structural design of formwork in timber, including plywood, and steel, with full information on the pressures exerted by concrete, and simplified formulae and nomograms for loading.

Extractive Metallurgy. By JOSEPH NEWTON. *Wiley, New York; Chapman and Hall, London.* (78*s*)

Essentially a revision and enlargement of the second part of the author's *Introduction to Metallurgy*, this book presents its subject by the unit process method, rather than metal by metal. Discussion of metal crystals, equilibrium diagrams and Gibbs' phase rule is introduced.

Thermodynamics and the Heat Engine. By DONALD H. MARTER. *Thames and Hudson.* (63*s*)

In an apologia for the appearance of yet another textbook on thermodynamics the author explains his purpose as the provision of a text suitable for use in the initial years of courses of study in heat engines, and leads from theory to application at an early stage in the book.

Directory of Shipowners, Shipbuilders and Marine Engineers, 1960. 58th edition. *Tothill Press.* (60*s*)

Well over 1,000 thumb-indexed pages of shipowners, builders, marine engineers, drydock owners, consultants, associations, classification societies, and other useful organisations. An alphabetical list of ships' names and owners is worth remembering.

Stahlbeton Tabellen. By KARL HOFACKER. *Verlag Leemann, Arbenzstrasse 20, Zürich.* (15 *SFrs*)

These tables will facilitate the design and dimensioning of composite steel/concrete members by giving areas and stresses involved in the rectangular or T-section reinforcement used.

Principles of Electricity and Magnetism. By Y. ROCARD. *Pitman.* (70*s*)

In this translation of his *Electricité*, a university level text based on lectures at the Sorbonne, Professor Rocard has attempted to give electronics its due place in the syllabus, without overlooking the more classic aspects of electricity.

The Petroleum Handbook. Compiled by Members of the Staff of Companies of the Royal Dutch/Shell Group. 4th edition. *Shell International Petroleum Company Limited.* (21*s*)

A review of the world petroleum industry serves to preface a compendious account of petroleum production, storage, transport and distribution, and the manufacture and applications of oil products and petrochemicals.

Performance and Efficiency Tests with Brush Traction Type 2 1,250 b.h.p. A-1-A A-1-A Diesel-Electric Locomotive No. D5516. *British Transport Commission.* (10*s*)

Tests carried out on both express passenger and heavy freight workings have demonstrated the locomotive's suitability for mixed traffic duties. Full details of special and service runs are given.

Plastics Engineering Handbook. Compiled by the Society of The Plastics Industry. 3rd edition. *Reinhold, New York; Chapman and Hall, London.* (120*s*)

Developments in the plastics field since the last edition appeared in 1954 have dictated a larger double-column format, containing several new chapters and general revision or rewriting of the remainder.

Residential Conference on Major Developments in Liquid Fuel Firing 1948-59: Proceedings at the Conference, held at Torquay, May, 1959. *The Institute of Fuel, 18 Devonshire Street, Portland Place, London, W1.* (42*s*)

Review papers presented at the conference included those covering liquid fuel developments in open-hearth furnaces, gas turbines and domestic heating, and in the metal, glass and ceramics industries.

Hotels and Restaurants Throughout the British Isles and N. Ireland, 1960. 32nd edition. *British Hotels and Restaurants Association, 88 Brook Street, London, W1.* (3*s* 6*d*)

Travellers will find this directory a useful companion. Details and prices of accommodation and meals are given, and a section of road and rail maps is appended.

Thermodynamics. By HERBERT B. CALLEN. *Wiley, New York; Chapman and Hall, London.* (70*s*)

Professor Callen introduces a new postulational approach in place of the conventional inductive development of thermodynamics. A knowledge of standard elementary calculus, plus a few special topics such as Legendre transformations and simple quadratic forms is called for.

The Reviewers

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Trade Publications

Copies of any of the following trade publications are obtainable from the addresses given, though distribution is sometimes restricted.

Plant and Equipment

Heat Transfer. BAKER PERKINS LTD., Westwood Works, Peterborough. Two items of heat transfer equipment: the Reactor and the Microfilm evaporator. Leaflets.

Gas Producer Plant. INTERNATIONAL FURNACE EQUIPMENT CO. LTD., Aldridge, Staffs. One and two-stage gas producer plant; its history and present form; illustrated in 19 page booklet.

Storage Bins. PRECISION COMPONENTS (BARNET) LTD., 13 Byng Road, Barnet, Herts. Kabi " Plasitbox " storage bins with transparent lids. Moulded in polystyrene or nylon from $3\frac{3}{4}$ in square to $19\frac{1}{2}$ in by $11\frac{3}{4}$ in. Leaflet.

Tape Perforator. CREED AND CO. LTD Telegraph-House, Croydon. Model 75 reperforating attachment, and also reproducer terminal set. Leaflets.

Bag Filters. W. C. HOLMES AND CO. LTD., Turnbridge, Huddersfield. Holmes-Retroflux bag filters. Five types with areas from 129 to 2,066 sq. ft. Publication 82.

Air Heaters. DAVIDSON AND CO. LTD., Sirocco Engineering Works, Belfast 5. Siroccofin gilled tube air heaters using steam. Dimensions and outputs for various steam conditions given in publication 63/59.

Proving Station. ALLEN WEST & CO. LTD., Brighton, 7. New electrical proving and research laboratories cover 7,500 sq. ft. with a mechanical testing room of 5,000 sq. ft below. Shock, vibration, and electrical tests can be carried out. Illustrated brochure.

Marketing

English Electric to Build Another 190 Locomotives

THE expanding modernisation programme of BRITISH RAILWAYS has led to another major order with the ENGLISH ELECTRIC Company—for 190 main-line diesel locomotives. The contract is worth £15 million.

The order, by BR diesel classification, comprises:—

Type			No.
1	1,000 h.p.	.. ..	78
3	1,750 h.p.	.. ..	37
4	2,000 h.p.	.. ..	75

Locomotives of all three types have been built for British Railways before. They will be built at English Electric group works at Preston, Newton-le-Willows and Darlington.

The Type 4 main-line locomotive is already in use on such outstanding services as the "Master Cutler" Pullman between King's Cross and Sheffield.

French to Build German Rockets

NORD-AVIATION, the state owned French aviation concern, are to make ground-to-ground rockets for the German army. The contract is worth more than £7 million.

Nord-Aviation has described the missiles, mainly for use against tanks, as unusually accurate.

Milling and Boring Machines for China

WILLIAM ASQUITH, of Shrewsbury, are at an advanced stage of work on the last two of five ram type horizontal milling and boring machines for China. The order, from the China national machinery import corporation, was obtained against intense foreign competition.

Four of the machines have a spindle diameter of 10 in and one has a diameter of 11 in. The company, a member of the ASQUITH MACHINE TOOL CORPORATION, understand that in addition to heavy engineering work the 350 ton machines will be used for the production of rolling mills and turbines.

The machines have been built at the Halifax and Shrewsbury Asquith works and final assembly carried out at Shrewsbury where a main bay 250 ft long by 50 ft wide, equipped with 75 and 25 tons cranes and an erection pit, allows two machines to be erected together.

Durgapur Starts Steel Rolling

The first day of steel rolling at the Durgapur steel works last month brought the 42 in DAVY-UNITED blooming mill into use—250 tons of ingots were rolled during the day.

Two days later the 32 in intermediate rolling mill started up.

Davy-United, a member of the British consortium ISCON, building the Durgapur steel works in West Bengal, has £29 million of commitments in the project. The company is responsible as main contractor for the main rolling mills, the wheel and axle plant, the central engineering maintenance shops and the iron and steel foundry.

Taking Ships to Columbus

Any British exhibition on Columbus Circle, New York, which omitted UK built ships would be odd indeed. At the exhibition opening today at the New York Coliseum whose address is Columbus Circle, the British shipbuilding industry is well represented at two impressive stands on the ground floor.

From ship models to a full size free-piston gasifier the exhibits describe British shipbuilding, marine engine building and ship repairing. A judicious blend of novelty to attract attention and detailed technical information is achieved by the research section.

The SHIPBUILDING CONFERENCE, sponsors of the industry's stands, have called a "Shipbuilding Day" for June 15. Shipowners, brokers, shipbuilders, and others interested have been invited to visit the stands. A long list of British shipbuilders is in New York for the exhibition and they will be visiting shipyards, research centres and port installations.

Perhaps over the cocktails they will be able to murmur a tactful word about the effect of United States marine discrimination and its world wide copying.

Putting Your Name on the Globe

PRESTIGE ADVERTISING, who devise ideas in gifts for presentation, have produced an inflatable world globe that may find an easy acceptance on many an export manager's desk.

With the name of the presenting company on the base, the obvious eye-catching effect of the globe, and its use in the occasional conference are turned to useful marketing effect.

This particular globe, which when inflated has the surface gloss of porcelain, is well suited to vigorous marking with crayon for indication of overseas sales effort and so on. The globe's cartography is completely up to date—at any rate for this year—and is presented with colourful contrast that makes it easy to read without being garish.

£28,000 Fire Detection Move by Hoover

The HOOVER Company has ordered a £28,600 fire detection installation for its Merthyr Tydfil washing machine works. Using more than 10,000 detector points over its estimated floor area of 350,000 sq. ft the installation is believed to be the largest single order for fire detection equipment to be placed.

The equipment is being manufactured by SOUND DIFFUSION (AUTO-THERMATIC), of Portslade, Sussex, who have put a similar installation into the Hoover, Perivale, factory.

Throughout the 38 factory zones of the Merthyr Tydfil works the auto-thermatic equipment should detect an outbreak within seconds, preventing by a speedy alarm the sort of early grip on roofing or other material of the type of fire that did so much damage at the Jaguar plant and others last year.

Hoover have now spent £50,000 on fire detection in the past year.

Tenders Soon for Purfleet Tunnel Approach Road

Work on the northern approach to the Dartford-Purfleet tunnel under the Thames is well ahead, and tenders are shortly to be invited for the southern approach road.

The £11 million scheme is expected to be carrying traffic in 1962. The approach will widen near the tunnel entrance in order to allow the traffic to stop for the payment of tunnel tolls.

The southern approach will include a two level junction with the A2. The northern approach links the tunnel with the Southend arterial road, A13, at a point between Purfleet and West Thurrock.

Diesel Electric Bulk Cement Carrier

A single screw diesel electric bulk cement carrier with a 1,750 ton cargo capacity has been ordered from HENRY ROBB Limited of Leith, Scotland, by WILSONS (NZ) PORTLAND CEMENT Limited, of Auckland, New Zealand.

The new vessel will have a FULLER HURON Airslide fluidising conveyor system for self-unloading Portland cement. It will also be fitted with FULLER KINYON pumps. This equipment is to be supplied by CONSTANTIN (ENGINEERS) Limited of Westminster, London.

The GENERAL ELECTRIC COMPANY are to provide the main propulsion and generating equipment. BELLISS AND MORCOM of Birmingham are to make the diesel engines.

Consulting engineers and naval architects acting for the owners are Sir J. H. Biles and Company, of Westminster.

The Sales Message in Many Tongues

If the old complaint of British firms sending out sales letters to remote lands with even remoter languages in business English has less force these days it is at least partly due to the efforts of the translation agencies.

One of the most recent to come on the commercial scene is TRANSLA Limited, who double translating with conference organising, working from Villiers Street, London. One of the agency's strong points is that its staff are only allowed to translate into their own languages.

Tropospheric Scatter Contract

A tactical scatter communications contract worth $2·6 million (almost £1 million) has been awarded to the WESTINGHOUSE ELECTRIC CORPORATION'S electronics division by the United States Air Force.

Six mobile radio sets, says the United States' Air Force, will be produced for use in aid of air weapon control systems. The tropospheric scatter communications system was developed by Westinghouse engineers. It is capable of relaying 60 voice channels over single leaps of 120 miles.

Sky Bolt Guidance Contract to Northrop

The ballistic missile computer for the guidance system of the United States' Sky Bolt air-launched deterrent carrier is to be made by the NORTHROP Corporation.

Northrop is a division of the LIGHT MILITARY ELECTRONICS Department of the GENERAL ELECTRIC COMPANY (America).

DOUGLAS AIRCRAFT are the main contractors for the Sky Bolt programme.

Plenty Tug Order for Calcutta

PLENTY AND SON, the Newbury, Berkshire, engineers, are to equip two tugs for the Calcutta Port Trust.

The £80,000 order was placed with Plenty by the HOOGHLY DOCKING AND ENGINEERING Company. A large part of the machinery will be constructed in India.

Leyland Active in Africa and Finland

The busily expanding LEYLAND MOTORS concern is setting up a new company in East Africa to cover Kenya, Uganda and Tanganyika. Already there are 2,000 Leyland vehicles in use in this vast stretch of country in which Leylands have plainly decided to be ready for future advancement.

The new organisation will be known as LEYLAND ALBION (EAST AFRICA) Limited. It has an initial spares stock worth £200,000. The Leyland set-up for Africa now extends from the Cape to Sudan, under the general guidance of the Leyland African office, in Johannesburg. The Leyland company is the culmination of service by its vehicles in the tough conditions of East Africa from the mid-1920s. Albion diesel buses maintained the first bus services in Nairobi and Mombasa in 1934 and 1935. Since the war Leyland vehicles inaugurated the 1,400 mile Great North traffic route through the Central African Federation to East Africa.

Finland has just ordered another 600 diesel engines from Leyland's industrial units division, bringing the number of diesels the Fins have ordered in three weeks from the company to 1,200, worth more than £500,000.

Boom Time for Aluminium

Aided to some extent by the shortage of scrap, the use of aluminium in the United Kingdom and abroad is increasing at an accelerating pace. The British aluminium imports in the first third of the year rose by more than 60 per cent over the same months of 1959, in which the imports rose by some 17 per cent.

For the moment the ALUMINIUM COMPANY OF CANADA, which is the largest exporter of the metal in the world and holds the ring in the matter of price, shows no sign of changing it from £186 a ton.

Aluminium Trains Save Power and Upkeep

Very little aluminium has been used in British trains up to now. Increasing production of diesel and electric locomotives and stock provides a grand opportunity for extending its use with all the economies it affords.

RECENTLY the Aluminium Development Association and the Institution of Locomotive Engineers held a joint symposium in London entitled "The Use of Aluminium in Railway Rolling Stock." Thirteen papers were presented and discussed, and the main points which emerged are summarised as follows—

Aluminium.—Today this term denotes not only the pure metal itself, but also its wide range of alloys; it is used in this sense hereunder, except where the context demands otherwise, when reference to pure aluminium is made.

Range of Alloys.—All have a high strength-to-weight ratio, and welding or mechanical means of jointing are easy and reliable. Table I gives the percentage of elements added to pure aluminium in some typical alloys used in railway stock. The two main groups, i.e. those which are cast or used in wrought forms, can be further subdivided according to whether they can be improved or not by heat treatment. In LM10, for example, heat treatment is essential to develop its normal specified properties.

Properties of Aluminium.—These are well known, especially its light weight which is roughly one-third that of steel. Table II shows the principal physical properties of pure aluminium, which (apart from the melting point) also apply approximately to its alloys. The mechanical properties of the alloys vary more widely, and considering wrought alloys only the minimum tensile strength is between 7 and 30 tons per sq. in and the percentage elongation between 7 and 18. The strength in compression is taken to be the same as the proof stress in tension, and the average ultimate shear stress may be taken as approximately 60 per cent of the average tensile strength.

TABLE II.—*Principal Physical Properties of Aluminium*

Weight (lb per cu. in)	0·098
Melting point (° C)	658
Coefficient of linear expansion (per ° C)	24 × 10⁻⁶
Elastic modulus (lb per sq. in)	9·9 × 10⁶
Torsion modulus (lb per sq. in)	3·5 × 10⁶
Poisson's ratio	0·34

TABLE I.—*Typical Alloy Compositions*

BS alloy designations	Cast or wrought	Alloying element percentages										Remarks
		Cu	Mg	Si	Fe	Mn	Ni	Zn	Pb	Sn	Cr	Ti	
LM 4	Cast	2·0-4·0	0·15	4·0-6·0	0·8	0·3-0·7	0·3	0·4	0·1	0·05	—	0·2	
LM 6	Cast	0·1	0·1	10·0-13·0	0·6	0·5	0·1	0·1	0·1	0·05	—	—	
LM 10	Cast	0·1	9·5-11·0	0·25	0·35	0·1	0·1	0·1	0·05	0·05	—	0·2	Ti includes Nb
N 4	Wrought	0·1	1·8-2·7	0·6	0·7	0·5	—	0·1	—	—	0·5	0·2	
H 15	Wrought	3·5-4·8	0·85	0·9	1·0	1·2	—	0·2	—	—	—	0·3	Duralumin
H 30 (includes H 19 and H 20)	Wrought	0·1	0·4-1·5	0·6-1·3	0·6	0·4-1·0	—	0·1	—	—	0·3	0·3	

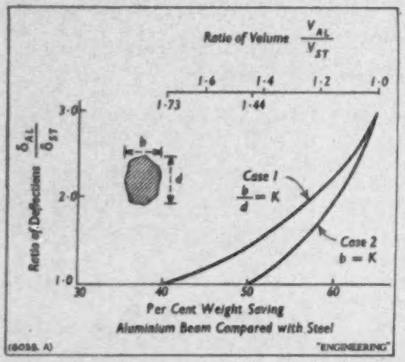


Fig. 1 (left) Graphical comparison between two aluminium beams and a steel beam under the same conditions of loading.

Fig. 2 (right) Extruded aluminium sections used in a BR diesel railcar.

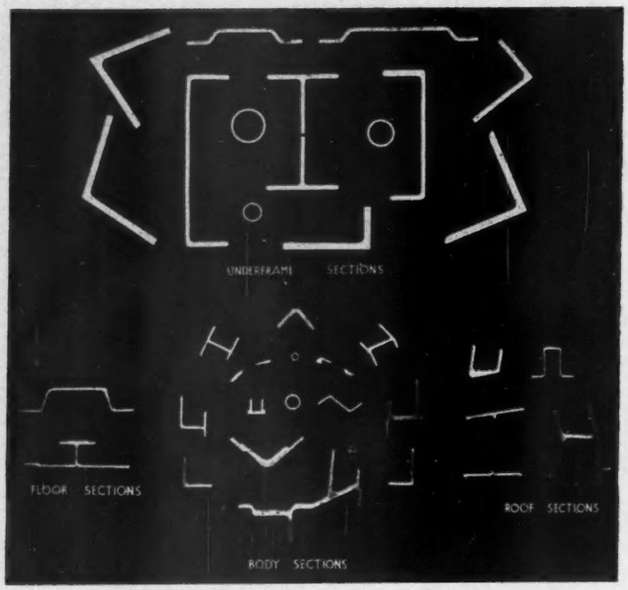
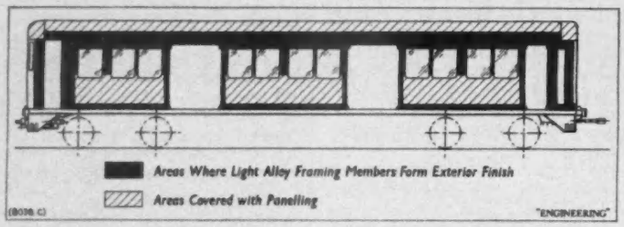


Fig. 3 (below) New LTE Metropolitan line motor coach of aluminium integrated construction.



The form of fatigue curve for pure aluminium and most of its alloys is similar to that of other non-ferrous metals and austenitic steels; it differs from the typical curve for mild steel as it does not become asymptotic to the axis, even after the test has been continued for a very large number of cycles. For most wrought aluminium alloys the fatigue strength varies between 6 and 9·5 tons per sq. in after 50×10^6 cycles, and in general the endurance limit lies between less than 30 per cent and over 50 per cent of the tensile strength.

Aluminium also has a high resistance to corrosion and high electrical and thermal conductivities.

Design Comparison with Steel.—Fig. 1 relates graphically weight saving, deflection and volume ratio of two aluminium beams with a given steel beam, all three having the same loading, span and method of support. Case 1 aluminium beam has breadth to depth ratio similar to the steel section, designed to give an equal deflection. This shows that a weight saving of about 40 per cent is possible with an increase of nearly 73 per cent in volume. Case 2 aluminium beam retains the width of the steel beam but its depth is increased to give a greater moment of inertia and this gives a weight saving of 50 per cent with an increase in volume of about 44 per cent. While it is not strictly correct to draw a direct comparison between cases of simple beams and the complex structure represented by a railway coach, it should be possible to obtain a weight saving of the order of 40 per cent in the basic structure, remembering to keep a check on the permissible deflection.

One important advantage offered by the lower elastic modulus of aluminium is that it allows a better distribution of stress in a composite structure and minimises the effect of poor fit. Also, when considering the relative cost of aluminium structures and their steel counterparts, the ratio of volumes is the factor directly affecting price. Too frequently misleading statements are made comparing on a price per unit weight basis.

Production of Sections.—All aluminium alloys are readily fabricated by the usual metal-working processes, and have good machining properties which permit the use of very high machining speeds.

The cold impact extrusion process is particularly valuable for railway vehicles in permitting the production of complex sections which can eliminate the necessity of further fabrication operations. Fig. 2 illustrates the variety of extruded sections used in the construction of British Railways lightweight diesel railcars Extrusions have the design advantage that their cross-sections can be individually tailored to the theoretical requirements of each member, or even combine the functions of several members in a single extrusion.

Coach Construction.—The extent to which aluminium has been incorporated in coach construction up to the present time falls broadly into two groups: (*a*) aluminium panelling with steel body frame and underframe, and (*b*) aluminium panelling, body frame and underframe designed as an integral load-carrying structure. Present day tendency is towards (*b*), though there are cases where awkward framework shapes imposed upon the design by outside factors result in heavier stresses in the frame members, thus favouring the use of a steel frame. London Transport's new Piccadilly Line tube cars provide a good example of this, whereas the new Metropolitan Line stock, having a much more generous loading gauge, are of aluminium

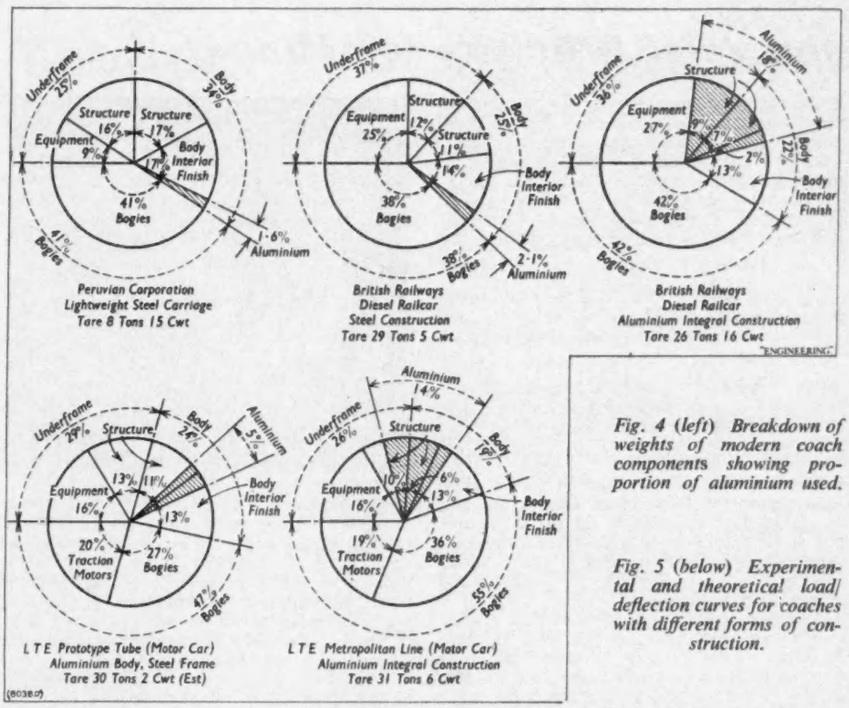


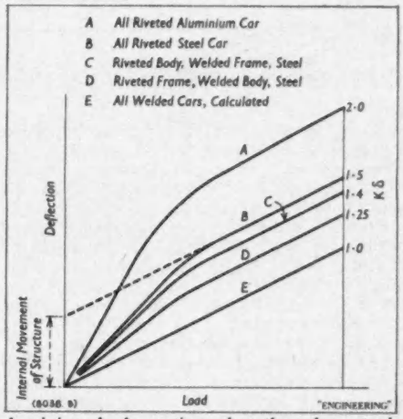
Fig. 4 (left) Breakdown of weights of modern coach components showing proportion of aluminium used.

Fig. 5 (below) Experimental and theoretical load/deflection curves for coaches with different forms of construction.

integrated construction. A particularly good example of the use of extruded sections is provided by these Metropolitan Line cars, wherein extrusions have been used to eliminate exterior panelling between the waist rail and the top of the roof coving, by combining the outer faces of the appropriate structural members with the outer face of the carriage, as shown in Fig. 3. This has saved about 1,500 panel rivets per car.

Even when construction (*b*) is employed it is usual to make certain of the more highly stressed underframe members in steel, for instance, the headstocks and bolsters where heavy buffing loads occur. Conversely, aluminium can be applied with advantage to some of the interior fittings, the function of which is either structural, decorative or both. Fig. 4 gives a breakdown of weights of the various parts of modern railway coaches illustrating the proportion of aluminium used in their construction. It will be noticed that no railway coach designers have yet seriously explored the possibility of using aluminium for coach bogies, considerations of high stress and shock loads coupled with the utmost reliability demanded having so far militated against developments in that direction.

Riveting versus Welding.—Welding of stressed aluminium frame sections is ruled out because in the fully heat-treated alloy, metal in the vicinity of the weld becomes softened by the heat. Welding can be used for joining the aluminium body sections, but these have to be riveted to the frame. Rivets are also used for joining the frame members, and for all aluminium to steel connections. Aluminium rivets are sometimes used but they are not entirely satisfactory for stressed connections, since they are fitted cold and have a low residual tension. Thus the disadvantage of riveted construction from the designer's point of view is that it does not provide a truly integrated body. During initial testing of early riveted designs the actual measured deflections exceeded the calculated figures by large margins. This was found to be due to minute rotation at riveted joints, hitherto assumed rigid. This joint effect cannot be calculated, but it has been determined empirically, and Fig. 5 shows typical load/deflection curves for coaches with different forms of construction. The joint effect of the aluminium riveted aluminium car is very marked. To overcome this steel rivets are often satisfactorily used where they are not exposed to the weather. Another measure which has been tried successfully is that of arranging a polythene film between the abutting joint surfaces to increase the rigidity.



Effect of Impact.—Aluminium is capable of absorbing greater impact loads than steel with less tendency to tear and distort, owing to its greater resilience. To simulate the condition of an integrated coach structure involved in a collision, a series of tests recently carried out on thin-walled tubes showed that there was a tendency for the damage to be localised near the impacted end. Therefore in coach design the headstocks and buffing gear should be designed to distribute a collision shock throughout the body structure, in the hope that in this event any damage will be localised as in the tube tests. Strong vertical struts at the coach end with rigid top and bottom fixings to the longitudinal roof and underframe members are clearly desirable, and they would also act as anti-telescoping fenders.

Stress Determination.—A real coach is a structure of some complexity, and stress calculations are only feasible in respect of an idealised frame. Whatever method of calculation is adopted, its accuracy will depend on how closely the idealised frame simulates the actual structure, and it is thus desirable to check the calculations by testing a model or full-size prototype. When an electronic digital computer is available the force-matrix method of analysis may be employed. This has certain advantages over the relaxation method, which does not need a computer; for instance it can be more readily checked and a greater number of unknown factors can be taken into account. But since the accuracy of the calculation depends finally on the initial idealisation, claims that it dispenses with the need for testing cannot be fully substantiated.

Conclusions.—The majority of the foregoing remarks apply as much to the use of aluminium in locomotives and wagons, as in coaches whether motorised or not. Two prime considerations stand out clearly in aluminium's favour, namely: (1) It lightens construction thus increasing the payload/deadweight ratio and saving traction power consumption.
(2) Its non-corrosive properties, due to formation of a self-oxidising protective film which does not detract from its appearance, mean that painting can be dispensed with and upkeep reduced.

What form further developments in its application will take is difficult to assess, but with the advent of additional information and improvements in manipulating and fabrication techniques, the future of aluminium looks extremely interesting.

One Valve for Control and Non-Return

For control of water flow in high and medium head hydro electric plants, or in other installations where similar control characteristics are required, the butterfly valve is widely used. In most pumping and water distribution schemes it is necessary to provide against reversal of flow, and this is usually done by means of a separate non-return valve installed in the pipeline.

To enable one valve to perform both functions, Boving and Company Limited, 41-47 Strand, London, WC2, have produced a butterfly valve which can be opened or closed by various types of control in the normal way, and which, if the water flow reverses, closes automatically. The valve is available in a range of sizes from about 4 in to 84 in bore, or larger. Besides having operational features which can be arranged to suit the particular site requirements, the valve obviously offers, in the larger sizes, an installation advantage in that it is not necessary to construct a separate chamber to accommodate a non-return valve.

The combined valve is based on the normal type of Boving butterfly valve, which has a disc with a metal cored sealing ring of rubber at its periphery. When the valve closes the inside of the ring is subjected to pipeline pressure, and this balancing of the internal and external pressures prevents the rubber from collapsing away from its seating in the valve body. Expansion of little more than 0·05 in effects a completely drop-tight sealing.

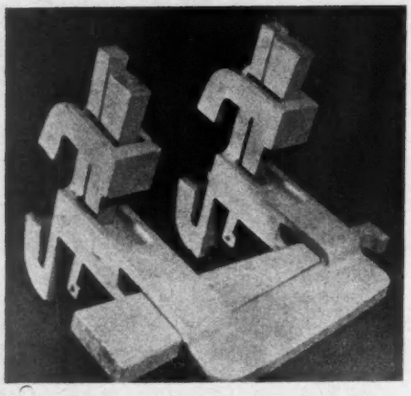
To accommodate the sealing ring the valve disc is asymmetric, and this gives it an inherent torque characteristic which causes it to close if the water flow is reversed. When the valve closes automatically, the ram used for normal control acts as a dashpot and prevents slamming. It can, of course, be closed by power at any time in the normal way. The design of an assymetric butterfly valve blade is cheaper than that of the normal blades.

Fabricated Cutters and Joist Brackets for Mining

As far as cost of labour and materials is concerned in mines, the actual getting of the coal comes first and close behind the provision of support. New items for both these aspects of mining have recently been announced by the National Coal Board. And although the design of the particular items is relatively simple, the improvement achieved is important because of the widespread use of mining equipment.

A fabricated drum has been designed to replace the standard cutting drum of the Anderton Shearer Loader. With it, increased speeds and reduced power consumption have been achieved. Two rows of pick boxes are provided at the face side of the drum to give a close sequence on the four inches nearest the coal face. On the remainder of the drum the pick boxes are distributed in a semi-helical manner, with pockets between the rows of picks. Large coal passes freely through the pockets, and recirculation is prevented.

(*Left*) *Fabricated cutters consume less power and helical pockets allow coal to pass freely from the coal face to permit faster cutting speeds.*



(*Right*) *Designed for locking forepole girders to mine roadway arches, the bracket provides a rigid connections for two joists crossing each other.*

A supporting bracket to provide a rigid connection for two joists crossing each other has been designed at the Board's Central Engineering Establishment. The bracket locks the forepole girders to the roadway arches, but it has much wider application. As shown in the illustration, the forepole girder would be supported inside a U shaped main body. The ends of the vertical arms of the U are shaped to form hooks which lock on to the bottom flange of the roadway arch. A wedge locks each hook to the flange.

A long wedge passes through the slotted sides of the U. Provision of appropriate tapers on the wedge and the bottom of the bracket ensures that the top of the wedge is flush against the bottom flange of the forepole girder.

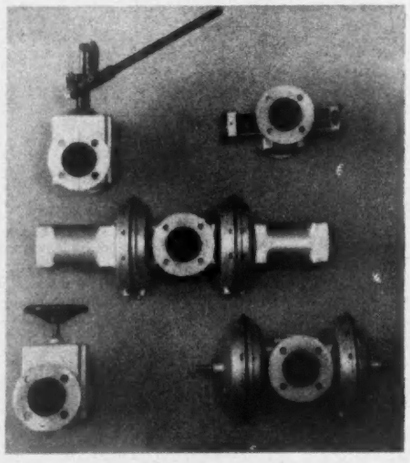
Mechanical Operation of Pinch Valves

Following industrial acceptance of their hand-operated pinch valves, W. H. Rowe and Son Limited, Bitterne Manor, Southampton, have introduced a range of designs suitable for operation by various types of power. In its simplest form the pinch valve has an internal flexible sleeve which is compressed, or pinched in, equally from both sides by a pair of moving anvils. When it is fully open, it has a full circular bore, which facilitates *in situ* cleaning.

Control systems now available include lever operation, to which a user can connect his own actuating mechanism, air cylinders and diaphragm motors. With lever operation, the valve can be operated by mechanical linkages, flexible cables, air or hydraulic cylinders. Built-on air cylinders enable the valve to be closed, and diaphragm motors can be arranged to open it or close it as required, the reverse movement coming from a spring. If the valve is fitted with an " air-to-open " drive, it fails to safety in case of a breakdown in the air or power supply, as the spring closes it immediately the air goes off. The push-rods driving the pinch anvils are extended to pass through the outer diaphragm chambers, so serving to indicate valve opening, and to act as references for positional controllers if required.

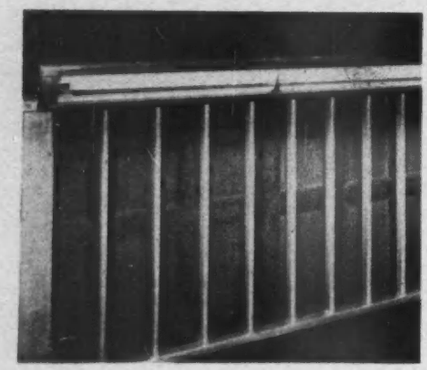
All the valves, except the air cylinder operated model, are available with bore diameters of 1, 2 and 3 in. The air cylinder valve is made with 2 in bore only, but it can be connected to 1 in or 3 in lines by means of tapered adaptors. Two additional sizes, 1½ in and 4 in bore, are available when the valve is hand operated.

Sleeves, reinforced for pressures up to 100 lb per sq. in, are made in six different grades, to suit various liquids and gases, and special grades of sleeve can be supplied to order.



Rowe pinch valves suitable for various forms of power operation are now available, as well as the original hand-operated model.

Aluminium Handrail with Built-in Lighting



Extruded sections of aluminium, containing flourescent tubes, form the main components of an illuminating handrail made for Onikan Bridge, Lagos.

A simple solution to the problem of illuminating bridges, dangerous corners and sections of motorways where overhead lighting would be prohibitively expensive is to use a lighted handrail. If the handrail can also be manufactured from attractive sections of extruded aluminium alloy, the architectural effect will be even more impressive.

Such a handrail, one section of which is illustrated, has been built to the instructions of Lagos Executive Development Board, for the new Onikan Bridge, Lagos. The construction is said to be unique. It was built by Saunders-Roe Structures Limited, to the order of Hastings of West Africa Limited, and under patents granted by Aluminium AG Menziken of Zurich.

In the main, aluminium extrusions to specification HE30WP are used in the construction of the handrail, and the sections are in 16 ft lengths. They are normally assembled while lying flat on the ground and lifted into a vertical position. The main stanchions have steel inserts for grouting into concrete. The sections are complete with all the necessary wiring.

The lighting assemblies, included in each section, comprise two 40 watt, 8 ft fluorescent tubes made by the International General Electric Company and supplied by BAG Turgi of Switzerland, together with transformers and bulb fittings. The fluorescent tube is sited in such a position that it does not dazzle approaching motorists.

Testing Aircraft Engines on the Ground

Extensive engine tests facilities are now nearing completion at the National Gas Turbine Establishment at Pystock. These facilities are intended for comprehensive research and development work on aircraft engines under simulated flight conditions.

THE Engine Test Facility (as it is now being called) at Pystock, Hampshire, is going to be large. It will use 1·7 million cubic feet of air per minute, will be supplied with 160 MW of electric power (it could use a maximum of 280 MW) and will require 2½ million gallons of cooling water per hour. It will comprise of four test cells, each designed for specific duties, which will between them span extremes of high and low pressure, temperature, flight speed and associated flight conditions for a variety of engines.

One of the many functions of ETF will be to provide a development service to industry. Engine manufacturers will have individual assembly bays where engines may be serviced for trial. Engine installation and handling

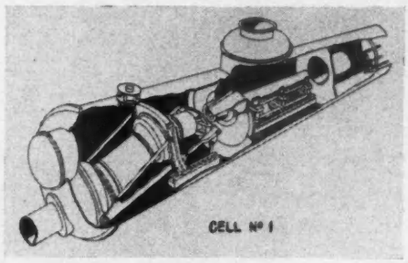


Fig. 1 Cell One will test small engines over a range of temperature, pressure and incidence.

problems have been emphasised throughout the design and exceptional provision is being made for the quick accumulation, computation and presentation of test data.

Cell One

The duty of the first of the four cells is to test, with supersonic air supply, small engines over a range of pressure, temperature and incidence to the air flow. The cell is 12 ft in diameter and with about 25 ft of length available for engine installation. The front of the cell is occupied by a variable incidence machine which holds the supersonic jet, while a bulkhead lower down the cell supports the spill diffuser gear which is mounted around the engine and reduces the pressure ratio and volume flow demand of supersonic testing. Up to a Mach number of 1·6, variable Mach number slotted nozzles may be used, but higher speeds are obtained by using fixed nozzles and the engine must be started at the required Mach number.

The cell may be supplied with either high or low pressure air, and exhausted either to atmosphere or to altitude conditions by air-operated ejectors. The test capacity of this cell is summarised most simply by stating that the limiting maximum intake size of an engine will be 18 to 20 in in diameter.

Cell Two

Cell number two is to undertake connected rig tests on any engine at high or low density but in no case will the supply temperature be sub-atmospheric. Fig. 2 shows the cell, in which the air supply to the engine passes through a floating thrust box after measurement in the supply lines while the exhaust is delivered either to atmosphere or altitude conditions by air driven ejectors.

Engine exhaust temperatures up to 2,000° K may be accepted. The air supply to this cell has an absolute maximum of 600 lb per sec, though later experience may dictate a rather lower unit. As in cell number one, the engine installation length can be up to 25 ft.

This cell can undertake high density tests up to three atmospheres ram supply pressure on the largest turbojet engines, and to even higher pressures in the range of prospective ramjet engines. It will not test large engines with complete exhaust expansion at supersonic altitude conditions, but provided the exhaust throat pressure is kept just choked it will test large engines (200 to 300 lb of air at sea level) at low pressure conditions; it is therefore specially valuable for reheat development and ramjet work of all kinds.

Cell Three

The job of cell number three is primarily to undertake low pressure connected testing, using the full volumetric capacity of the plant over a much wider range of inlet air temperature. This includes power absorption tests on turboprop engines and complete expansion trials on supersonic turbojet and ramjet engines. The cell and its associated equipment is laid out to provide rapid changes of pressure, temperature and flow.

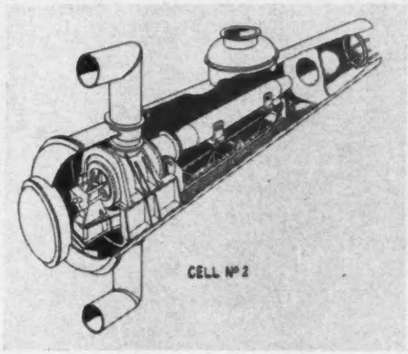


Fig. 2 Cell Two will make connected rig tests on any engine at high or low density.

It is 20 ft in diameter and consits of two sections, the first 20 ft long and the second 60 ft long. The upstream chamber is used both as the test station for turboprop engines connected to dynamometers and as a plenum chamber for other engines when installed in the downstream section. A permanent water-cooled diffuser at the outlet of the cell will give some recompression of the higher speed supersonic engine exhausts to permit this form of testing on the largest engines. Once again engine exhaust temperatures of 2,000° K are acceptable.

Cell Four

The fourth cell is to undertake supersonic inlet testing with the largest engines over as wide a speed range as possible. A variable Mach number supersonic nozzle with flexible walls, which allows for quick speed changes, blows air at the engine mounted within variable geometry spill diffusers. The nozzle and diffuser system is of rectangular geometry to permit area and shape adjustments which in torn raise the aerodynamic efficiency. The nozzle can be swung to give incidence of the engine relative to the free jet. A by-pass compressor is used to suck air from the boundary of the free jet and deliver it back to the diffuser outlets. This practice both improves the efficiency of the diffusers and helps to regulate the jet flow pattern. The aerodynamic efficiency of the system is sensitive to incidence and to the flow disturbances caused by engine flow reduction.

A system of this sort can be built on two main arrangements. In the first, the engine flow is exhausted separately back to atmosphere and the spill by-pass flow is constantly recirculated by the remaining compressors with the engine loss made up by a dried inbleed from atmosphere. With given compressors this system is the most expensive but also gives the largest working section and permits the widest variety of testing on the largest engines at the lower Mach numbers.

The other main arrangement would be to use the compressors to suck the joint engine and spill diffusion exhaust through a common cooler and pump it straight back to atmosphere, i.e., an open circuit system. This arrangement leads to a smaller test section, no more than three-quarters of the size of the closed circuit arrangement, and therefore implies some restriction on the variety of engine testing at lower speeds. In effect the larger sizes of engine cannot be tested over as wide a range of operating conditions. However, this arrangement has a compensating advantage that it can more conveniently be taken to higher speeds in the range Mach 3 to 4 and that its initial cost is lower.

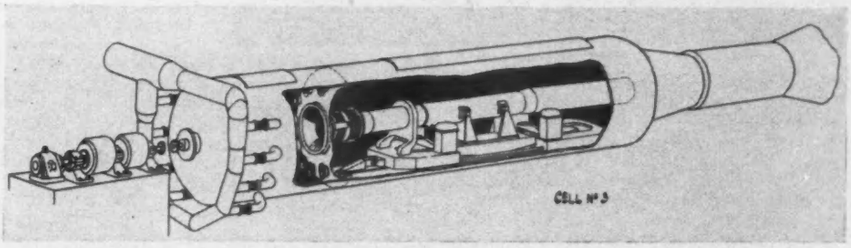


Fig. 3 Cell Three will primarily undertake low pressure connected testing over a wide range of inlet air temperature.

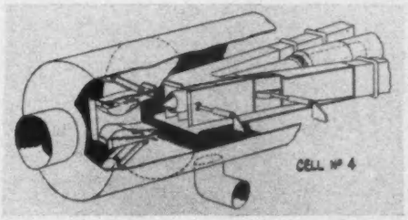


Fig. 4 Cell Four will carry out supersonic inlet testing with the largest engines over a wide speed range.

The engineering problems of the two systems are very similar and, in the main, are thought to have been solved. It seems probable that the open circuit system will be adopted, in which any engine with a diameter of about 40 in can be usefully tested.

Many Sciences at New Research Centre

With the recent regrouping of the constituent companies of Associated Electrical Industries, changes have been made in order to rationalise the research effort. A new laboratory has now been opened at Harlow, Essex.

THE scope of a company's research activities must obviously be related to the size and importance of the company, and to the diversity of its range of products. In the case of AEI (Woolwich) all three of these factors—size, status and range of products—are big, so that it is not at all surprising that their newly opened laboratories at Harlow deal with an uncommonly large variety of engineering sciences.

For convenience of administration, the work of these laboratories is divided into eight sections: phosphors and photoconductors, transistors, magnetic materials, vacuum physics, image tubes and electron optics, metallurgy, chemistry and materials, and telecommunications.

(Left) A mass spectrometer leak de'ector (seen in its magnetic field by the operator's left hand) is used to check the glass-to-metal seals of silicon diodes.

(Above) Work is now in progress on an optical image intensifier which combines the techniques of image converters and television pick-up tubes.

The wide variety of these headings gives an indication of the diversity of the research programme that has been instigated to meet the demands of the newly formed AEI (Woolwich) group. The reasons for both the choice and the diversity of these topics can be understood from the make-up of this new group, which includes such well know names as Henley's Telegraph, Siemens, Edison and Swan.

Since radio valves, television tubes, transistors and other electron devices form so large a part of the produce from the Woolwich group, it is not surprising that the vacuum physics laboratory features prominently at Harlow. The work of this section embraces the detection and analysis of gas leaks into cathode ray tubes, valves and transistors; the fundamental study of oxide coated cathode behaviour in the presence of various gases; and investigations into the mechanisms of chemical getters, which are used in all vacuum devices to clear up gases during the working life.

HOLDING A VACUUM

Leaks as small as 10^{-9} micron-litre per second can now be detected by using a simple mass spectrometer which has been developed by the AEI research staff. In addition, a great deal has been discovered about the nature of leaks, which in turn has given useful clues to their causes. From this research has come a technique for quickly vetting mass-produced cathode ray tubes on the production line, for quality sampling certain of the parts used in the make-up of a cathode ray tube, and for measuring and detecting leaks in component seals such as are used in the manufacture of transistors.

Gas leaks through porous ceramic in the range 10^{-4} to 10^{-7} micron-litre per second have been investigated, their properties determined, and the laws of gas flow established. This exact knowledge of the nature of a leak in ceramic material has been most useful, and has enabled a ceramic leak of known properties to be employed as a standard against which ionisations gauges can now be calibrated. Furthermore, a device incorporating this technique can now be used to calibrate vacuum gauges for all gases and vapours, whereas previous techniques have only enabled calibration for permanent gases. A particularly good example of the importance of this new technique occurred recently when assistance was given to the thermonuclear section of AEI at Aldermaston to interpret spectroscopic data by defining the sensitivity of an ionisation gauge for the gases methane and diborane. Neither of these gases could have been handled in the conventional manner since they are both condensible and unstable.

GAMMA RAY CRYSTALS

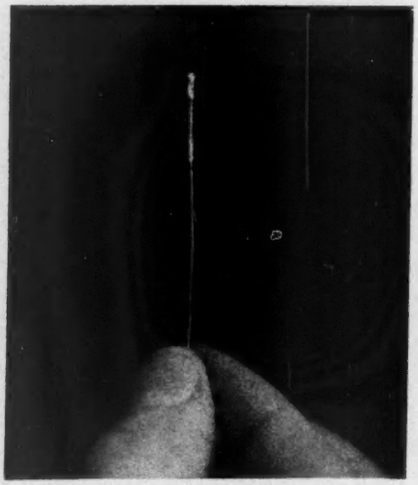
Perhaps the most exciting activity currently being pursued by the phosphors and photo conductors laboratory is that of producing and experimenting with pure cadmium sulphide crystals. When used as radiation detectors, single crystals of cadmium sulphide have a sensitivity per unit area comparable to that of a photomultiplier and respond to both visible and high energy radiations (such as ultraviolet and gamma rays). The ability of these crystals to detect high energy radiation has aroused considerable attention recently in the medical and nuclear energy fields.

Cells incorporating these crystals have been developed by AEI for the intracavitary measurement of gamma ray doses in the human body. In these, a crystal of cadmium sulphide is enclosed in a gold capsule, which performs the dual function of absorbing low energy radiation and acting as the return electrode. The cell has an axially symmetrical response and, located in a patient's interior, can be employed to measure accurately the gamma ray absorption of human tissues and organs. This is of great importance in the therapeutic use of radiation.

Previously such absorption was thought to be comparable with that of an equivalent volume of water, but this method has demonstrated that in fact there is pronounced difference.

In the nuclear energy field, cadmium sulphide cells would appear to be most suitable devices for detecting radiation over a large area. This would make them eminently suitable for use as safety monitors in nuclear power stations and as multipurpose devices for use in radiochemical laboratories.

Any sealed-off high vacuum device which detects processes or displays two-dimensional information comes within the scope of the image tubes and electron optics laboratory. At present, interest is centered on the conventional black and white cathode ray tube, but colour television and certain electronic applications in communications may dominate the field in the future. In order to gain experience in the techniques and theory of this subject, work is now in progress



A tiny cell, containing a crystal of cadmium sulphide, can be used for the intracavitary measurement of gamma ray doses in the human body.

on a number of specialised tubes which involve advanced techniques. Notable among them is an electron image intensifier and an optical image intensifier.

ELECTRON MICROSCOPY

Conventional electron microscopy has already provided a means by which a highly magnified image can be viewed directly on a flourescent screen, but this has two major disadvantages. Firstly the image can only be viewed directly through a small window, thus restricting the number of viewers. Secondly, while an electron beam of sufficient intensity is essential to the clear focusing of the image, the specimen under examination may suffer if the required beam is too strong.

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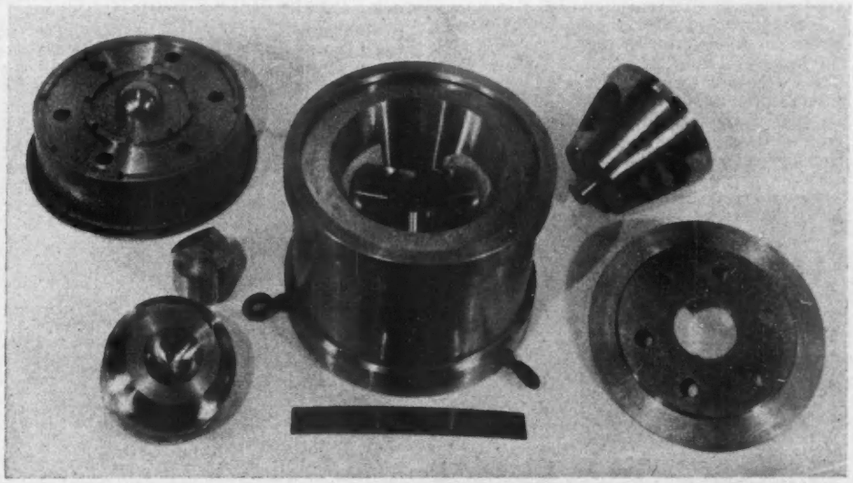

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Many Sciences at New Research Centre

With the recent regrouping of the constituent companies of Associated Electrical Industries, changes have been made in order to rationalise the research effort. A new laboratory has now been opened at Harlow, Essex.

THE scope of a company's research activities must obviously be related to the size and importance of the company, and to the diversity of its range of products. In the case of AEI (Woolwich) all three of these factors—size, status and range of products—are big, so that it is not at all surprising that their newly opened laboratories at Harlow deal with an uncommonly large variety of engineering sciences.

For convenience of administration, the work of these laboratories is divided into eight sections: phosphors and photoconductors, transistors, magnetic materials, vacuum physics, image tubes and electron optics, metallurgy, chemistry and materials, and telecommunications.

(Left) A mass spectrometer leak detector (seen in its magnetic field by the operator's left hand) is used to check the glass-to-metal seals of silicon diodes.

(Above) Work is now in progress on an optical image intensifier which combines the techniques of image converters and television pick-up tubes.

The wide variety of these headings gives an indication of the diversity of the research programme that has been instigated to meet the demands of the newly formed AEI (Woolwich) group. The reasons for both the choice and the diversity of these topics can be understood from the make-up of this new group, which includes such well know names as Henley's Telegraph, Siemens, Edison and Swan.

Since radio valves, television tubes, transistors and other electron devices form so large a part of the produce from the Woolwich group, it is not surprising that the vacuum physics laboratory features prominently at Harlow. The work of this section embraces the detection and analysis of gas leaks into cathode ray tubes, valves and transistors; the fundamental study of oxide coated cathode behaviour in the presence of various gases; and investigations into the mechanisms of chemical getters, which are used in all vacuum devices to clear up gases during the working life.

HOLDING A VACUUM

Leaks as small as 10^{-9} micron-litre per second can now be detected by using a simple mass spectrometer which has been developed by the AEI research staff. In addition, a great deal has been discovered about the nature of leaks, which in turn has given useful clues to their causes. From this research has come a technique for quickly vetting mass-produced cathode ray tubes on the production line, for quality sampling certain of the parts used in the make-up of a cathode ray tube, and for measuring and detecting leaks in component seals such as are used in the manufacture of transistors.

Gas leaks through porous ceramic in the range 10^{-4} to 10^{-7} micron-litre per second have been investigated, their properties determined, and the laws of gas flow established. This exact knowledge of the nature of a leak in ceramic material has been most useful, and has enabled a ceramic leak of known properties to be employed as a standard against which ionisations gauges can now be calibrated. Furthermore, a device incorporating this technique can now be used to calibrate vacuum gauges for all gases and vapours, whereas previous techniques have only enabled calibration for permanent gases. A particularly good example of the importance of this new technique occurred recently when assistance was given to the thermonuclear section of AEI at Aldermaston to interpret spectroscopic data by defining the sensitivity of an ionisation gauge for the gases methane and diborane. Neither of these gases could have been handled in the conventional manner since they are both condensible and unstable.

GAMMA RAY CRYSTALS

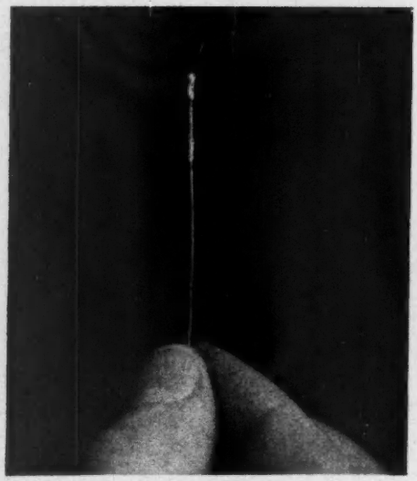
Perhaps the most exciting activity currently being pursued by the phosphors and photo conductors laboratory is that of producing and experimenting with pure cadmium sulphide crystals. When used as radiation detectors, single crystals of cadmium sulphide have a sensitivity per unit area comparable to that of a photomultiplier and respond to both visible and high energy radiations (such as ultraviolet and gamma rays). The ability of these crystals to detect high energy radiation has aroused considerable attention recently in the medical and nuclear energy fields.

Cells incorporating these crystals have been developed by AEI for the intracavitary measurement of gamma ray doses in the human body. In these, a crystal of cadmium sulphide is enclosed in a gold capsule, which performs the dual function of absorbing low energy radiation and acting as the return electrode. The cell has an axially symmetrical response and, located in a patient's interior, can be employed to measure accurately the gamma ray absorption of human tissues and organs. This is of great importance in the therapeutic use of radiation.

Previously such absorption was thought to be comparable with that of an equivalent volume of water, but this method has demonstrated that in fact there is pronounced difference.

In the nuclear energy field, cadmium sulphide cells would appear to be most suitable devices for detecting radiation over a large area. This would make them eminently suitable for use as safety monitors in nuclear power stations and as multipurpose devices for use in radiochemical laboratories.

Any sealed-off high vacuum device which detects processes or displays two-dimensional information comes within the scope of the image tubes and electron optics laboratory. At present, interest is centered on the conventional black and white cathode ray tube, but colour television and certain electronic applications in communications may dominate the field in the future. In order to gain experience in the techniques and theory of this subject, work is now in progress



A tiny cell, containing a crystal of cadmium sulphide, can be used for the intracavitary measurement of gamma ray doses in the human body.

on a number of specialised tubes which involve advanced techniques. Notable among them is an electron image intensifier and an optical image intensifier.

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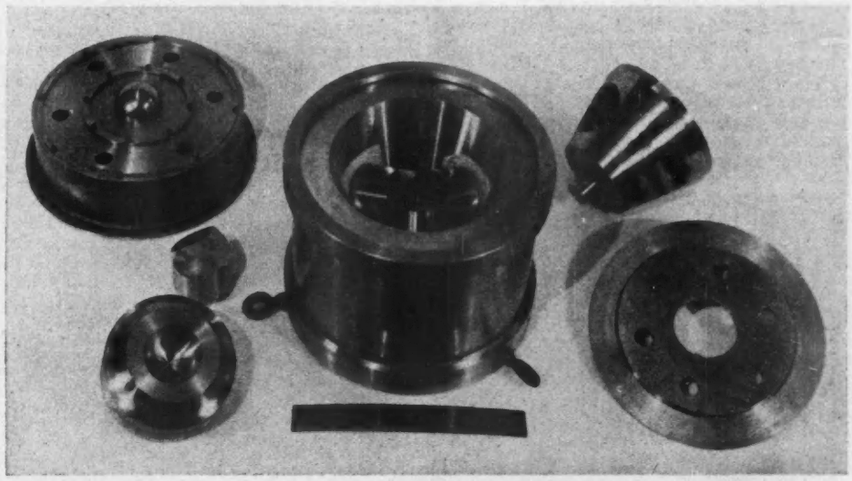

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All Run by Sunshine

PLANS are now well advanced for the actual building in this country of a bungalow that depends on sunshine for its heat, and sewerage wastes for its light and power. It is part of a plan for a self-contained 1·2 acre estate producing most of the food required for the family.

The main problem in the past has been the storage of the heat from the sun during the summer for use in the winter. It is claimed for the present design that this has been solved by using a sufficiently large volume of earth below the actual building. Full calculations have been made based on conditions over several years and show that, providing the storage volume is large enough, sufficient heat can be retained for the whole winter season.

On the flat roof of the bungalow are rows of parabolic boilers concentrating the sun's rays on to longitudinal tubes. The reflectors involve a new idea and consist of mirrors made from 0·001 in aluminised plastic film, stretched over end frames to give the true shape. The result is an extremely light and tough construction. Along the centre run pipes carrying water that is brought to boiling point by the concentrated rays. A thermal expansion correcting device is fitted to keep them always at the focus of the foil mirror. An outer covering of glass gives protection from weather.

Steam generated in these boilers passes through an ejector to operate the humidity control for the house and cool the rooms during summer. The spent steam then passes down a central flue to underground pipes where it condenses, giving up heat to the ground. As a result the local ground temperature is raised above ambient, forming the heat store for winter requirements.

The roof of the bungalow.

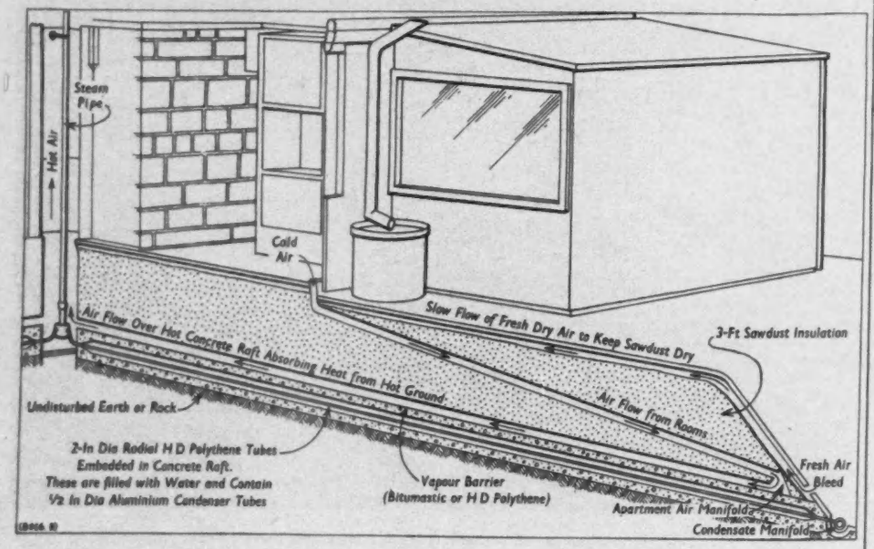
To avoid heat losses to the atmosphere, the effective ground area is covered with an insulating layer of sawdust 3 ft thick. The bungalow is built on studding extending through the sawdust to a foundation raft below. The raft is made of aerated concrete to reduce temperature stresses and is provided with a continuous H.D. polythene damp course. Within the concrete raft are 64 radial pipes leading from a central chamber and carrying the steam and condensate. They are joined at the periphery to a common annular pipe from which the condensate is recirculated to the boilers. This distilled water can also be used as the drinking supply for the household.

When heating is required for the rooms during winter, it is obtained by air circulation. Cold air from the rooms is drawn off at floor level and passes through pipes to an annular manifold at the periphery of the pedestal. It then filters back across the concrete raft (flowing above the damp course but below the sawdust) to the centre where it passes up a central flue to distribution ducts in the roof space. These take it to the various rooms as desired.

Thermal circulation occurs and the estimated temperature of the air ascending the central flue is 120° F. In hot weather, cooled air of controlled humidity can be circulated to the rooms through the same ducts.

Although the initial cost of such a bungalow would be slightly higher than a conventional one (the present plans are for three bedrooms, living rooms, kitchen, etc.) the running costs would be much lower since the energy of the sun is free. The economy of the estate is completed by collecting rainwater from the roof and storing it in a pool for domestic uses (other than drinking), passing the waste to a septic tank and thence to a fishpond. Some of the nutrients would there be converted to fish for food, and water would be pumped away for irrigation of the rest of the garden and lawns to produce all the vegetables and dairy products required. At the same time methane from the tank could be drawn off and used to drive a gas engine as the source of electricity for lighting and heat for cooking. The household could therefore be virtually independent of main supplies of water, electricity and gas, and would need no solid fuel. The food from the gardens would also materially reduce the shopping bill.

Inventor and designer of the bungalow is Mr. Arthur Capps of Crowthorne, Berkshire. Mr. Martin Capps, his son, carried out the theoretical heat balance calculations as his thesis for a higher degree.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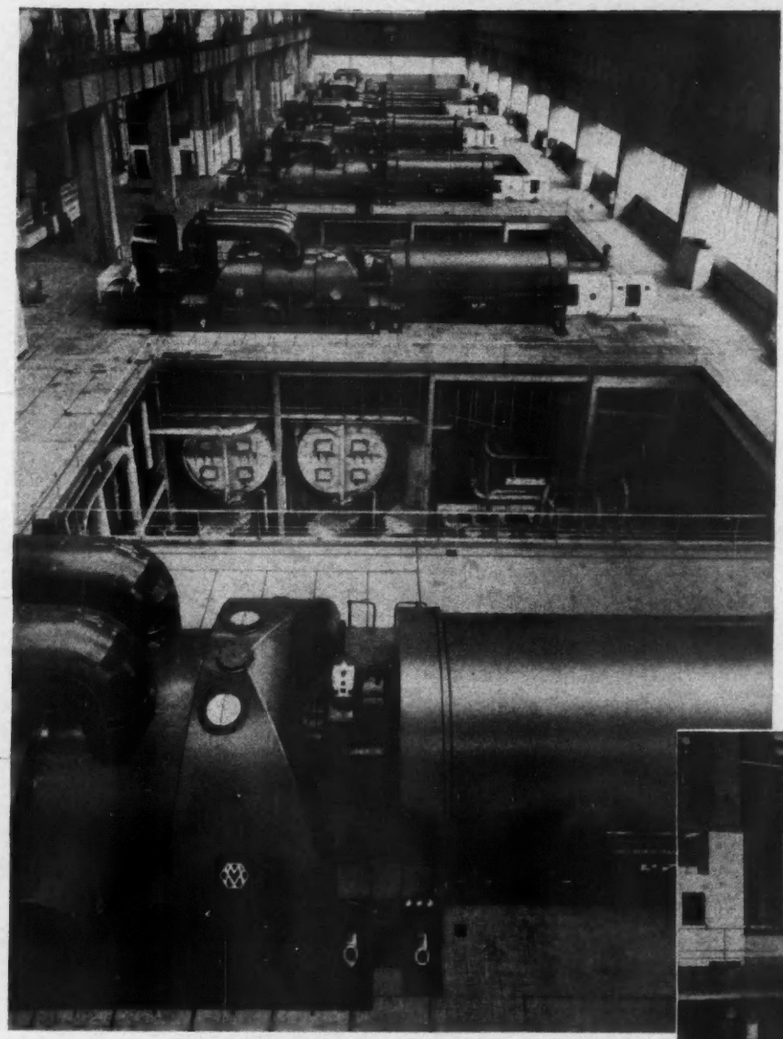

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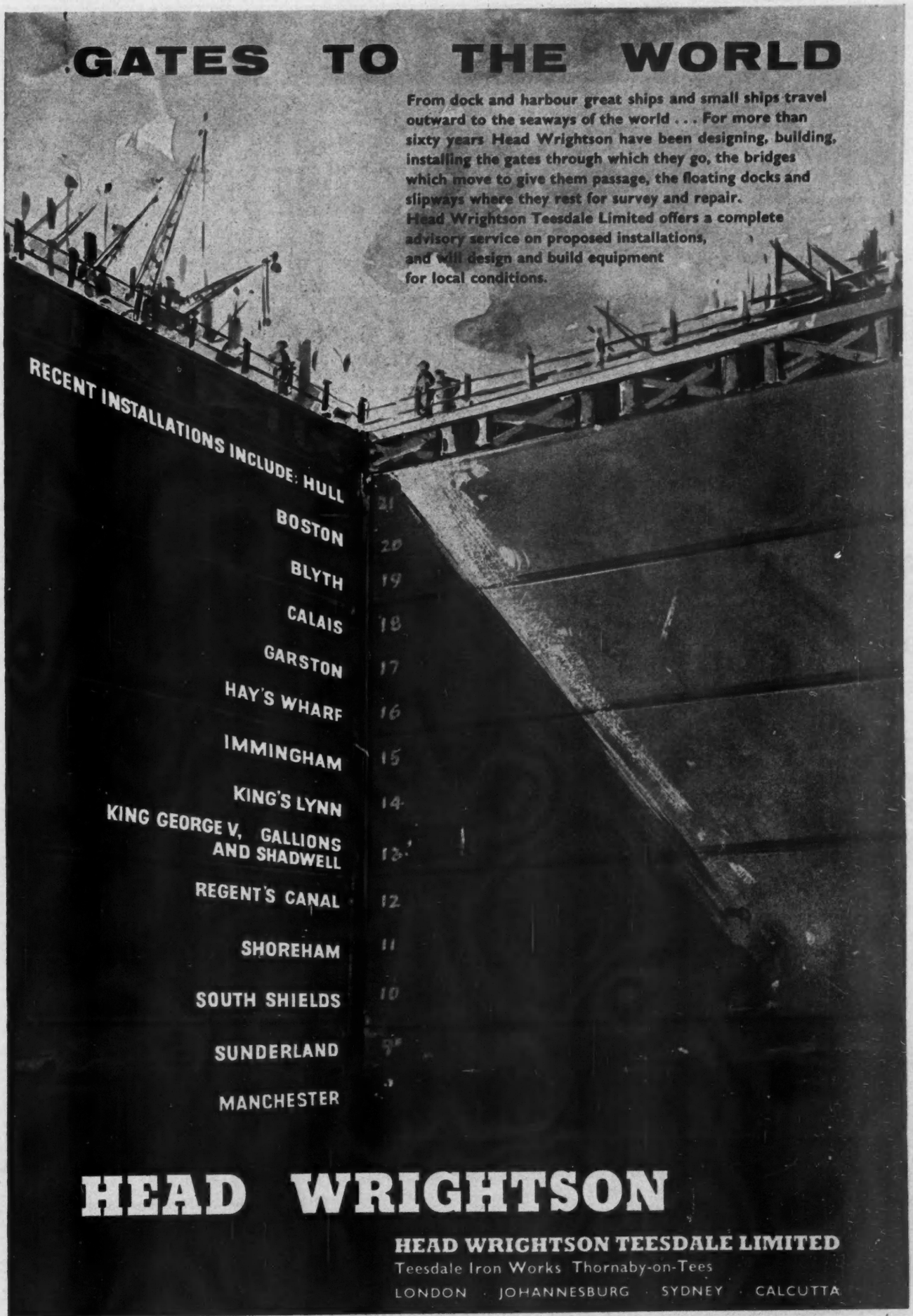
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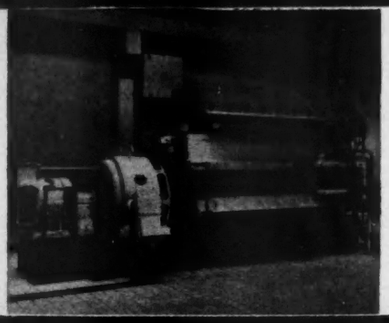

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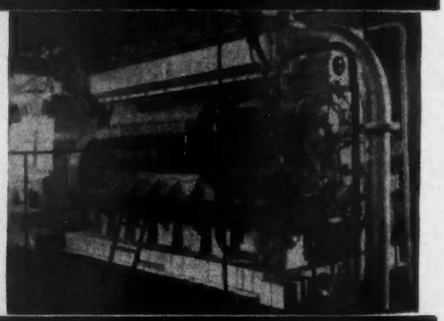

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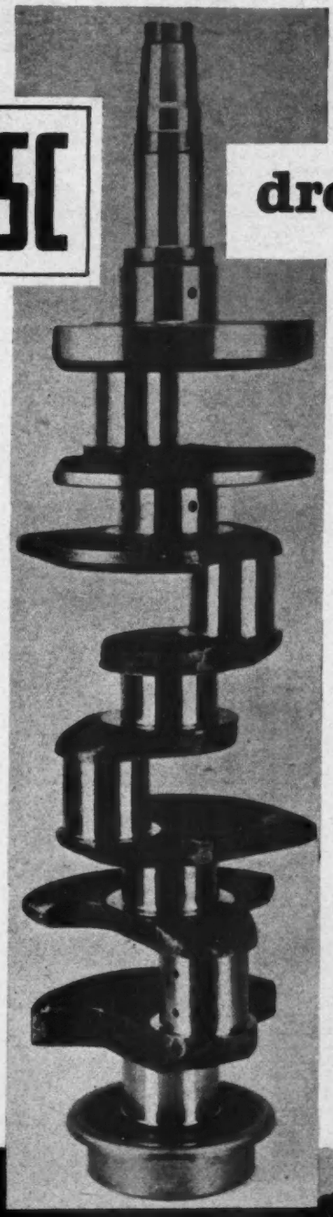
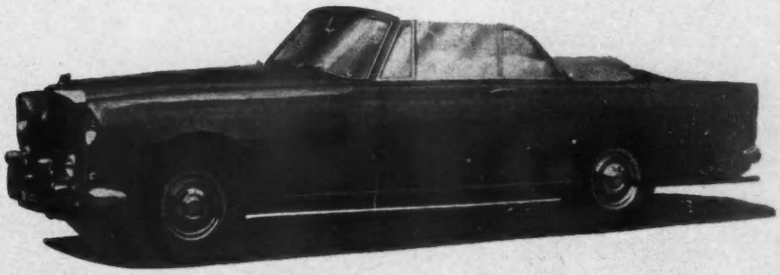


are used in the new $6\frac{1}{4}$ litre V.8. engine in the Rolls-Royce Silver Cloud II and Bentley S 2 Continental



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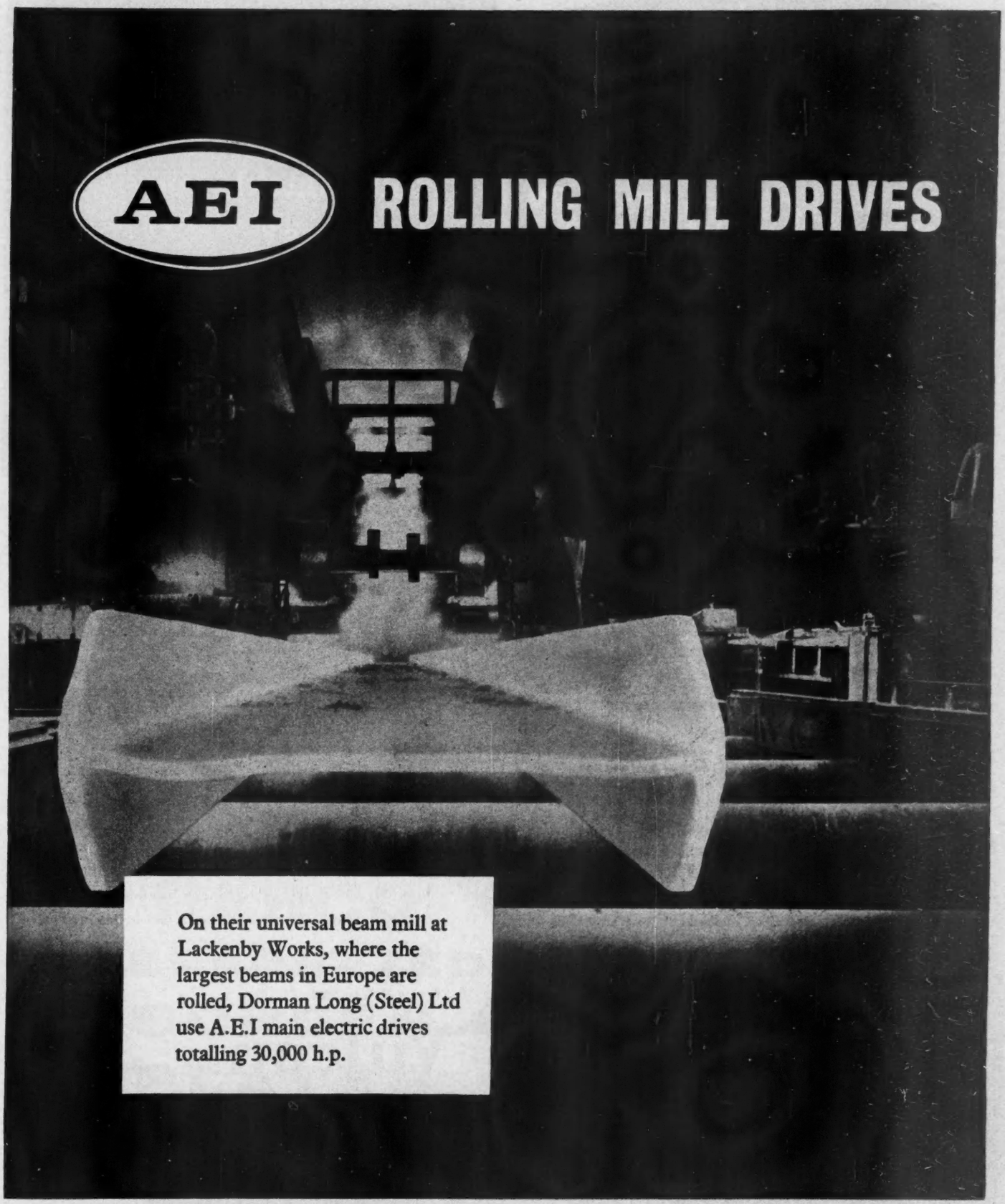
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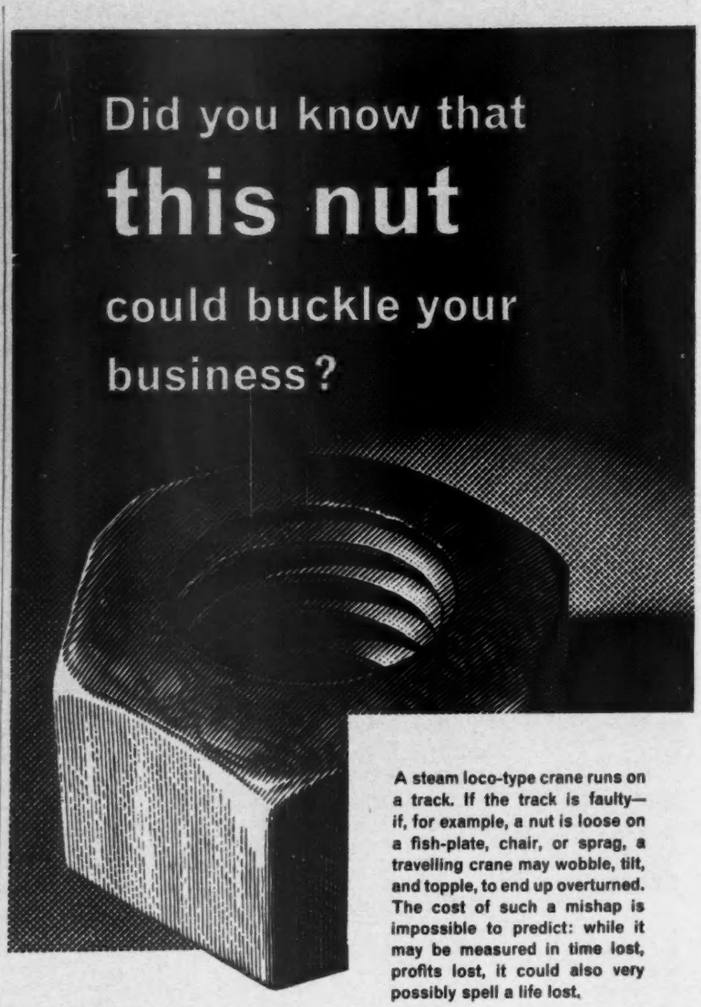

A steam loco-type crane runs on a track. If the track is faulty—if, for example, a nut is loose on a fish-plate, chair, or sprag, a travelling crane may wobble, tilt, and topple, to end up overturned. The cost of such a mishap is impossible to predict: while it may be measured in time lost, profits lost, it could also very possibly spell a life lost.

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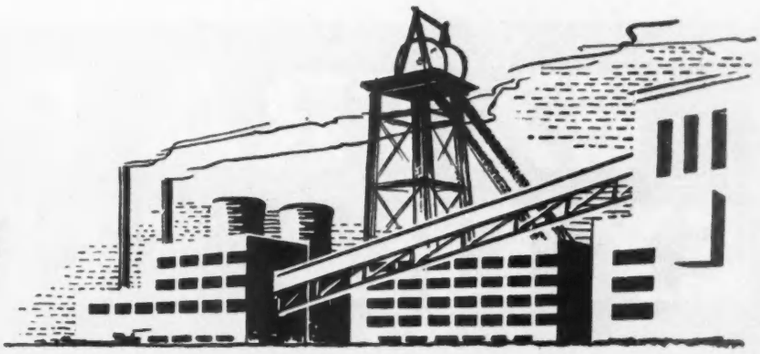

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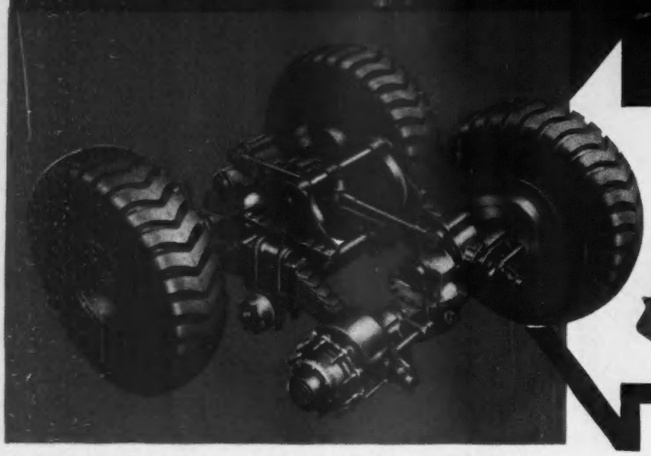

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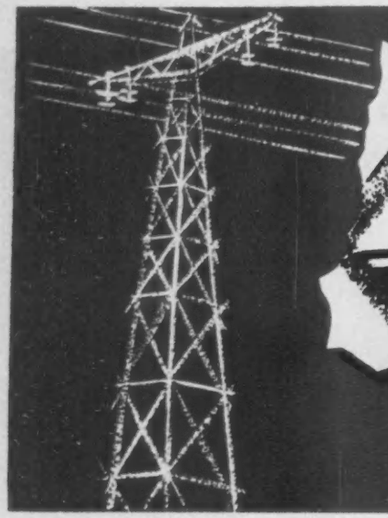

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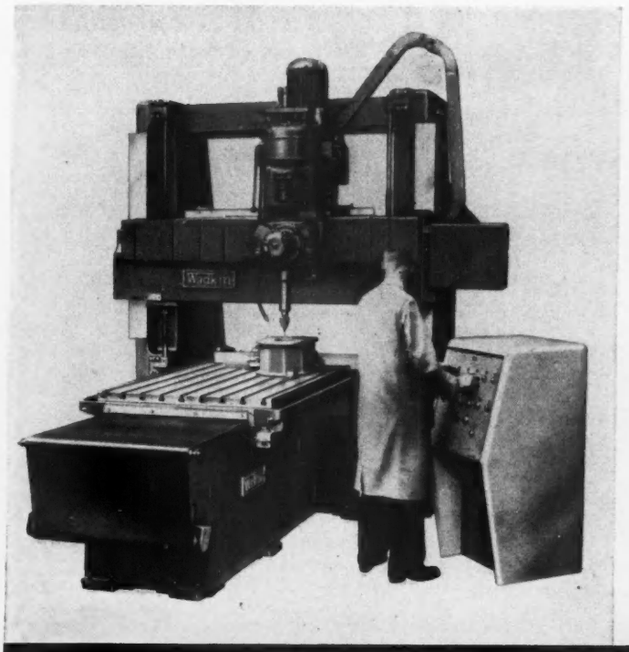

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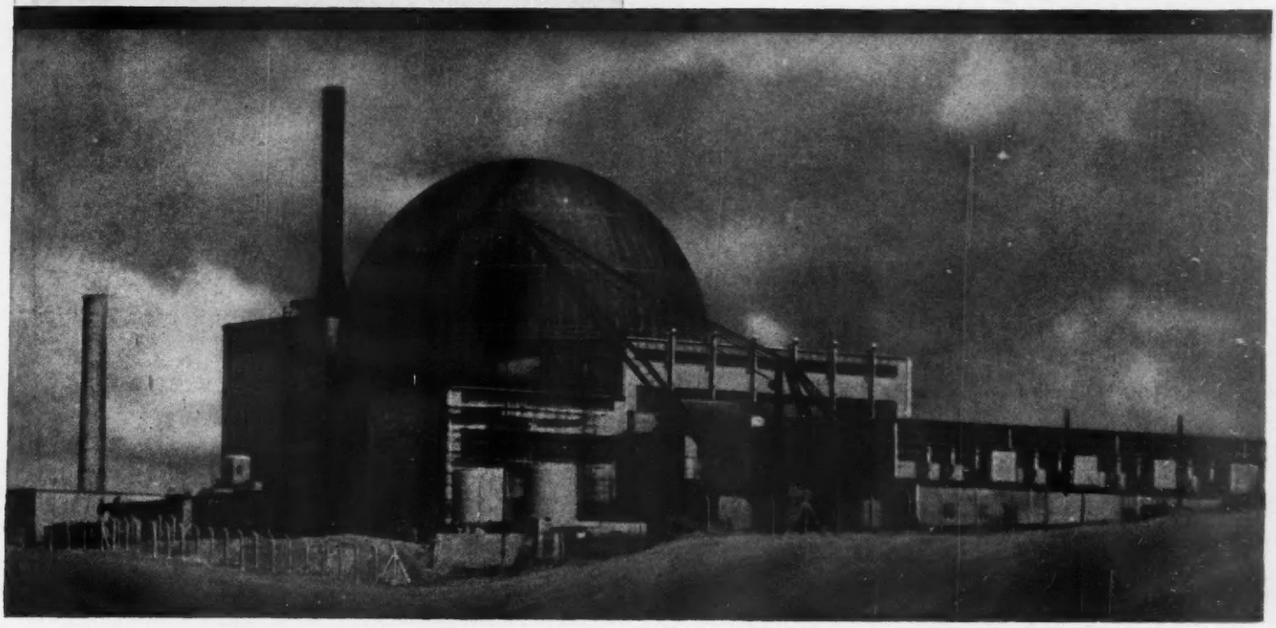

Rotax Recirculating Ball Threads are over 90 per cent efficient. All ball threads and nuts are completely reversible, but locking devices can be supplied if required. Stabilised and made of special materials, they remain accurate indefinitely. 'Clean' nuts simplify fitment.

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Standard Shaft length ..... up to 20′
(Longer lengths can be supplied for specific applications)
Standard Pitches ..... 200″ 218″ 250″ 500″
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Shaft diameter ..... up to 4″
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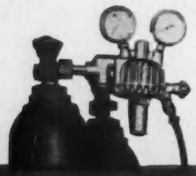

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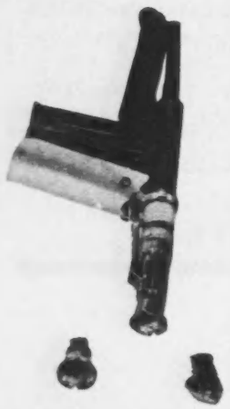
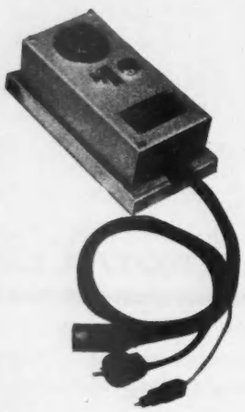
Spot, Plug and Tack Welding Nozzles (1 nozzle shown fitted to standard Hand Gun



Type C.P.L. Timing Unit for Spot, Plug and Tack Welding



Occupying less than 6 sq. ft. of floor space, this compact unit offers these great features:

- ★ Completely self-contained. The Lincoln-Cloos C.A.3 Welding Unit incorporates its own re-circulating water cooling system and gas bottle support.
- ★ Highly efficient modern design Hand Gun — can be used for both semi-automatic seam and spot welding.
- ★ The special type C.P.L. timing unit and nozzle for Spot, Plug and Tack Welding (illustrated) can be easily fitted in a matter of minutes.
- ★ Infinitely variable wire drive unit.
- ★ Wire feed rolls adjustable to suit wires of varying diameters.

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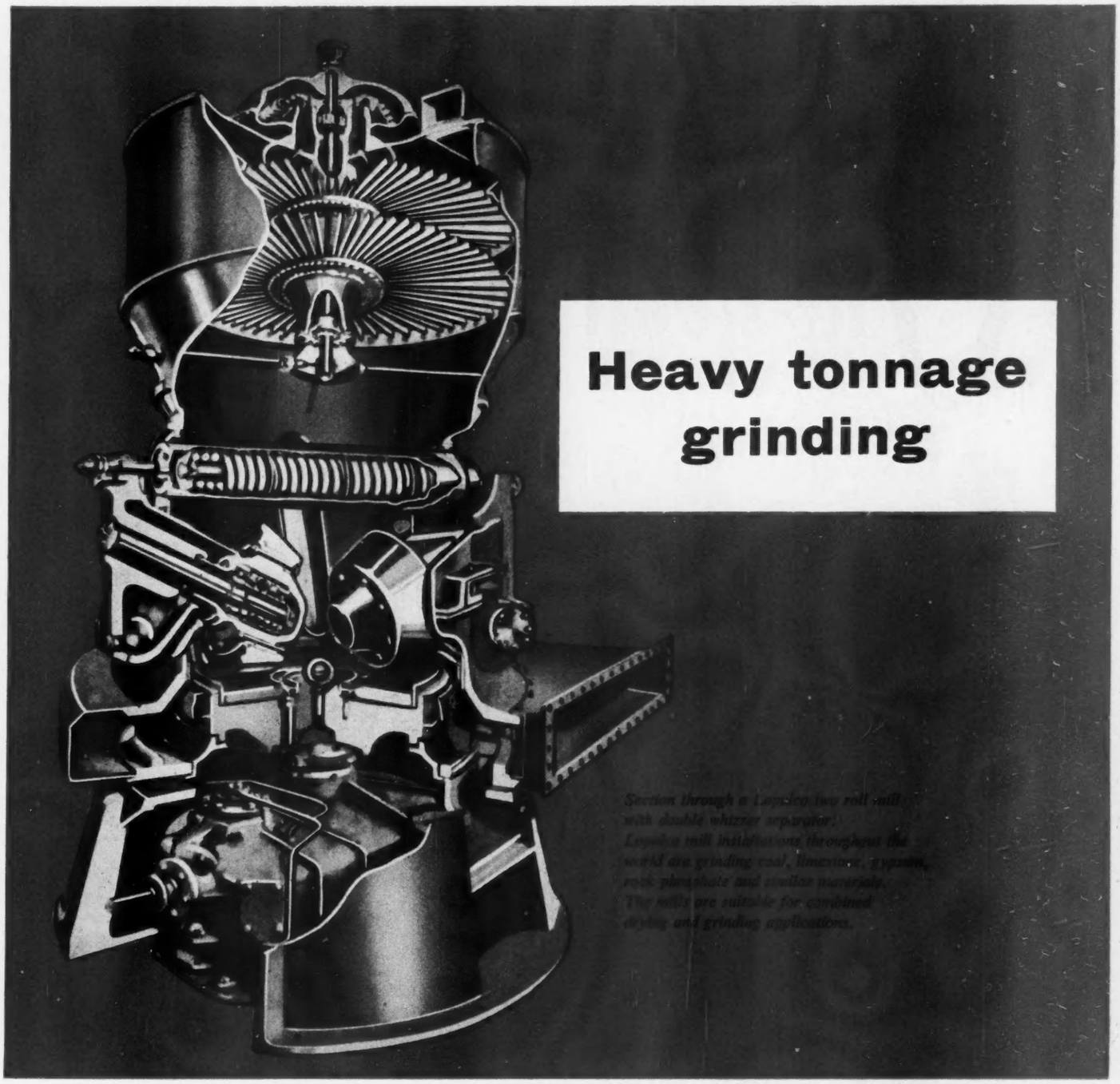

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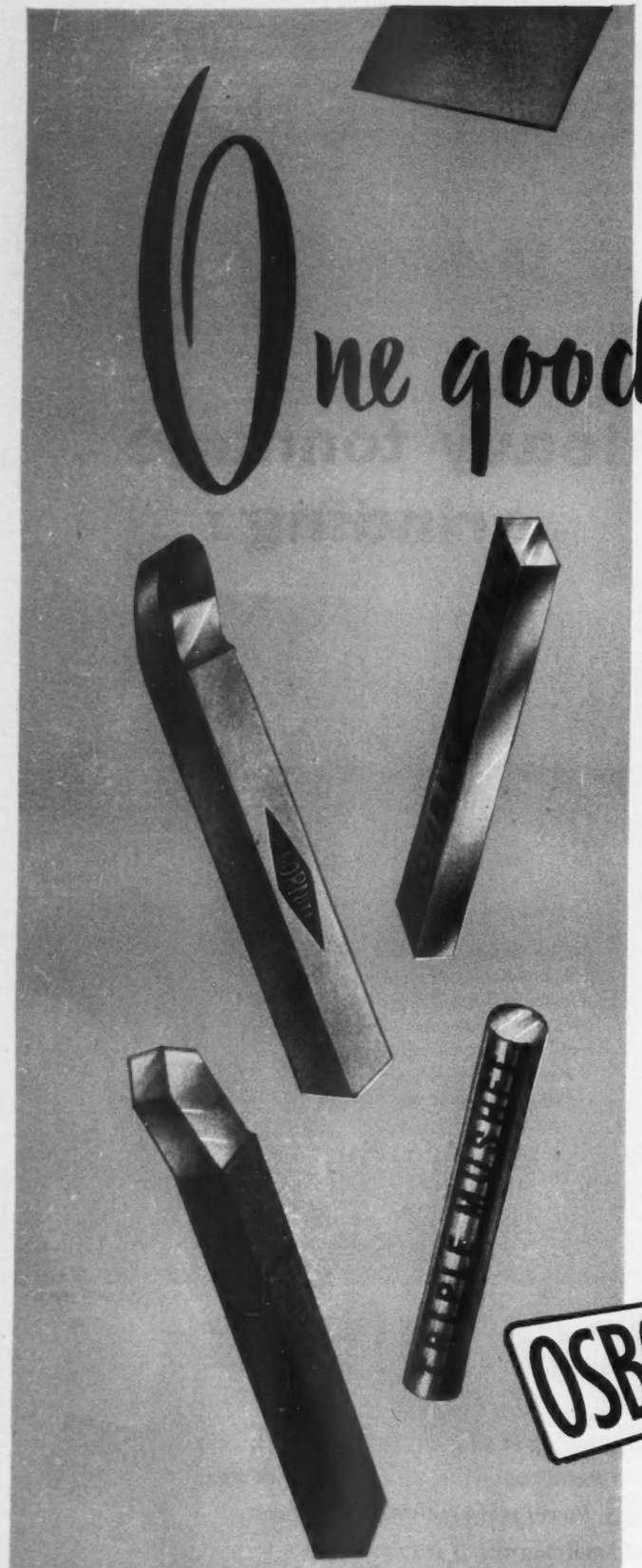

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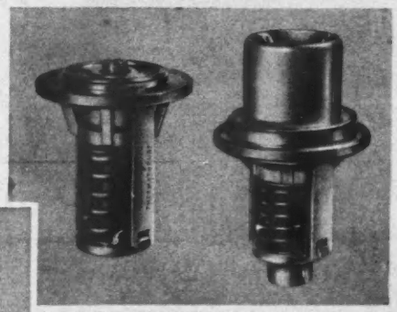

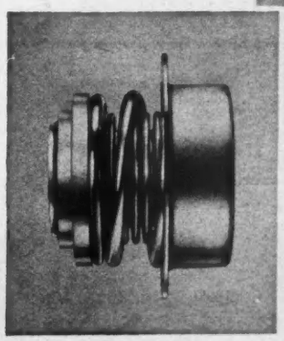

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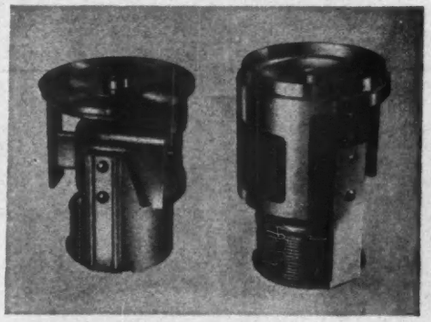
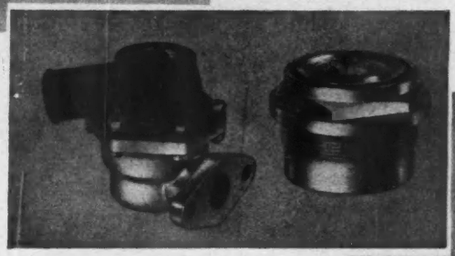


ENGINE COOLANT THERMOSTATS



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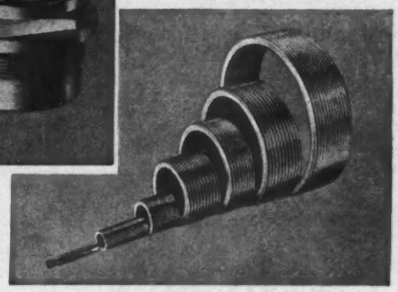

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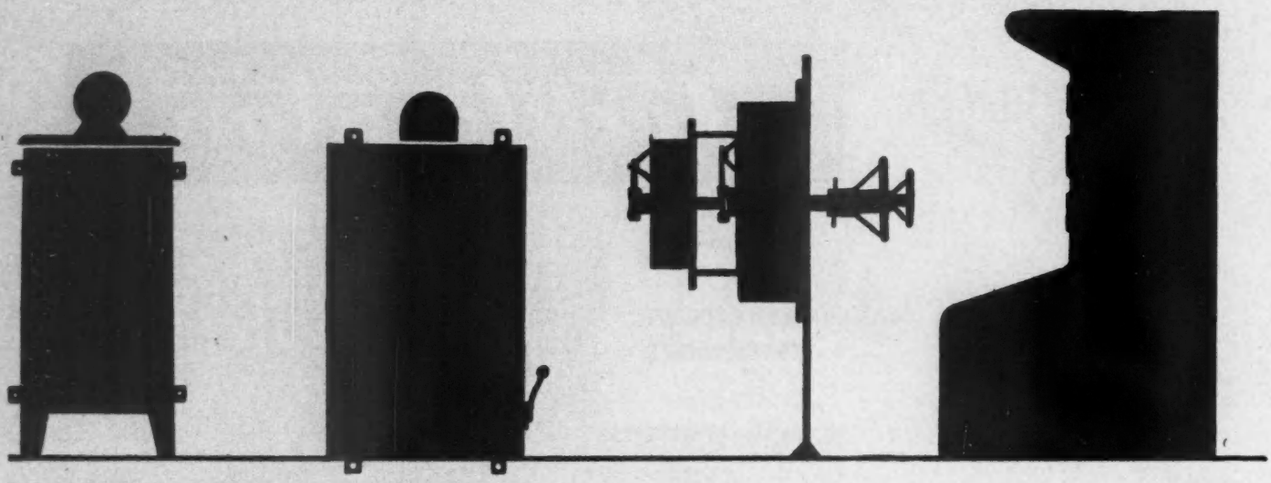
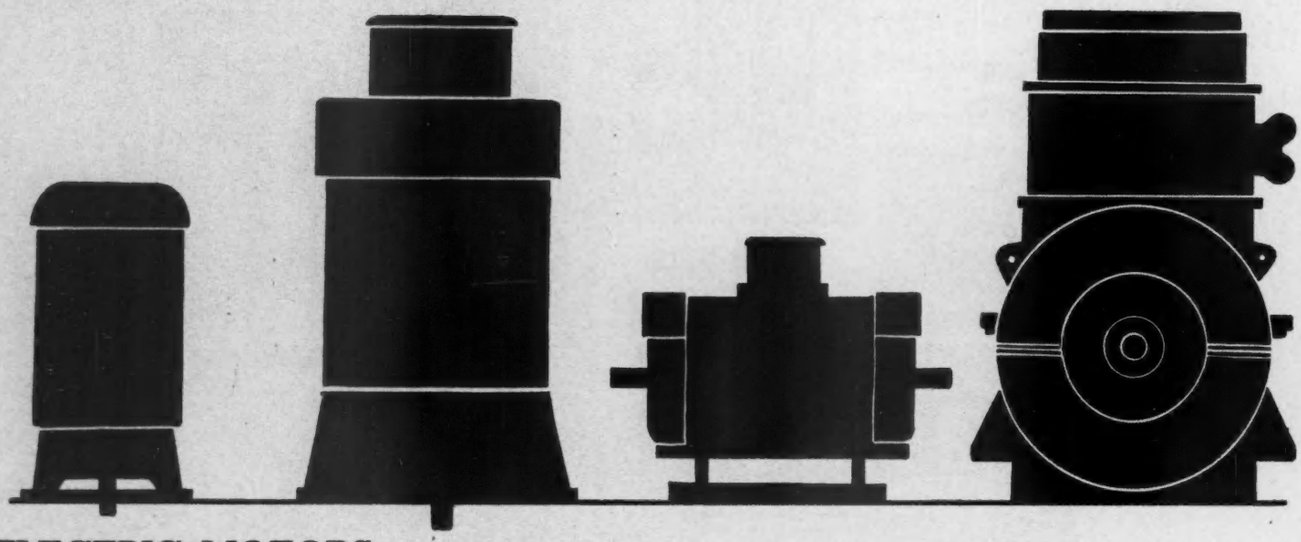


MOTOR CONTROL GEAR



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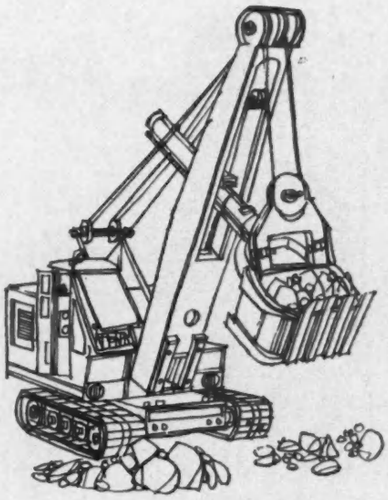

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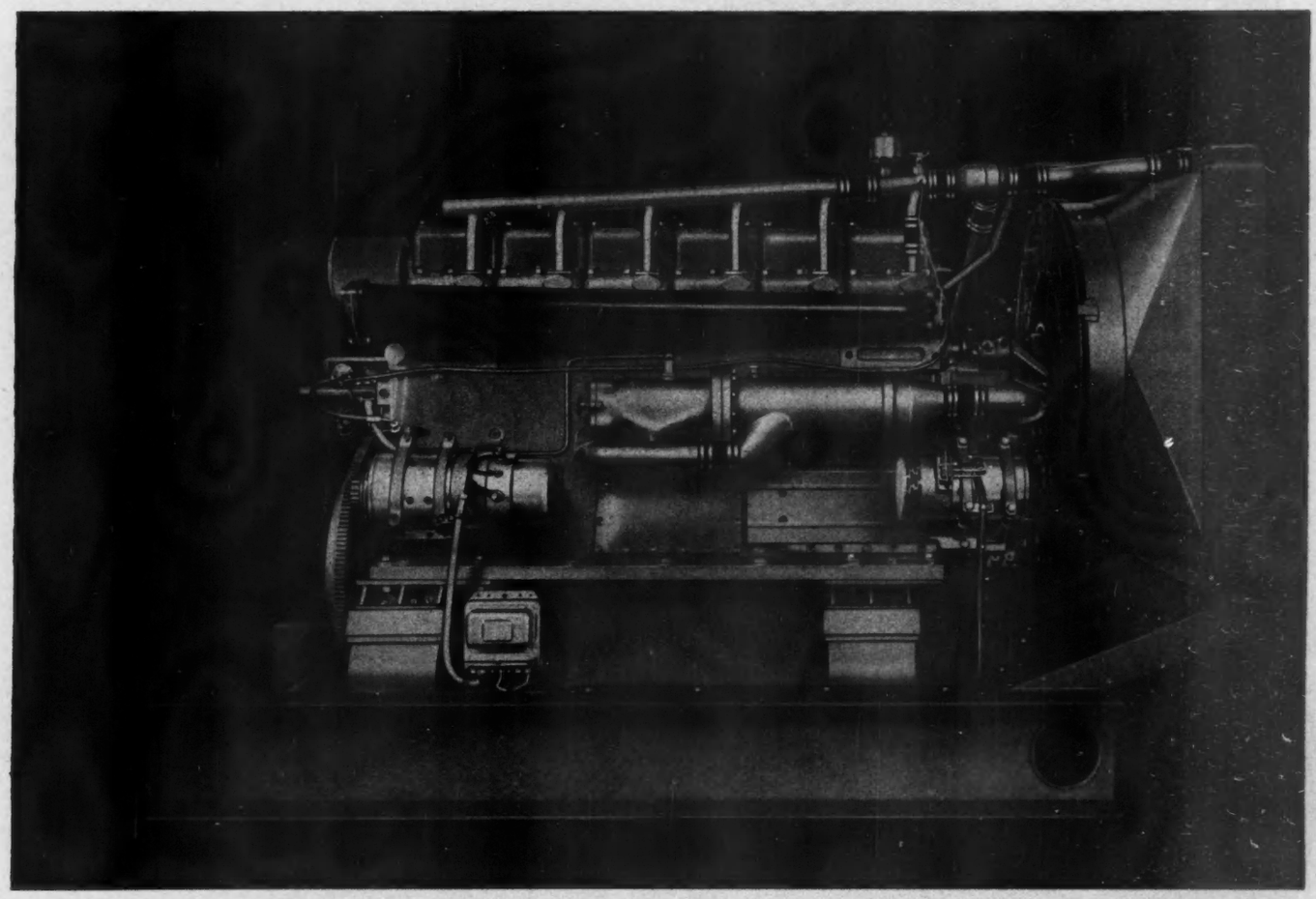

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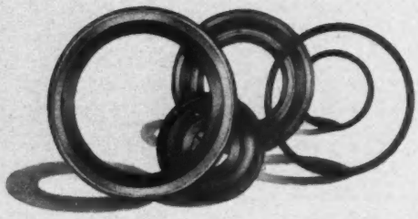

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machine tool exhibition: four special numbers of 'Engineering'

'Engineering' will publish four special numbers—June 17 and 24, and July 1 and 8.

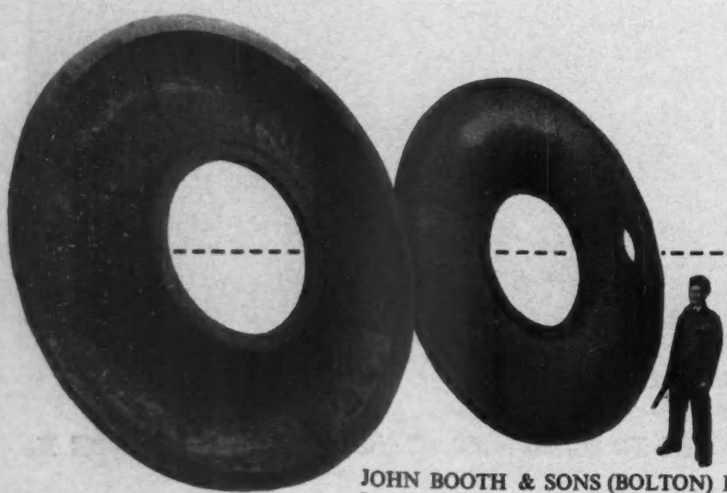
June 17 issue: special articles will include—

Future Trends in Manufacturing Techniques, by F. Griffiths, Chief Production Development Engineer, British Motor Corporation. How Hydrostatic Drives Might Change the Shape of Conventional Machine Tools, by D. Firth, A.M.I. Mech. E., Fluid Mechanics Division, National Engineering Laboratory.

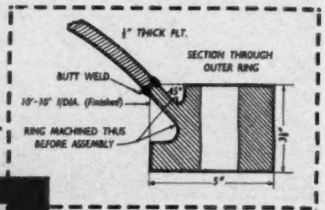
Also six pages describing and illustrating the first of four groups of new exhibits at the exhibition; and there will be extra notes and articles on current production topics.

First special number of 'Engineering.'

next week June 17



The two mild steel electrically welded heads for Dryers used in the paper-making industry are 12 ft. in diameter and each weighs 2¾ tons. The sketch shows how the solid ring has been machined out and prepared to receive the shell plates. The segmental plates are pressings produced in our own works.



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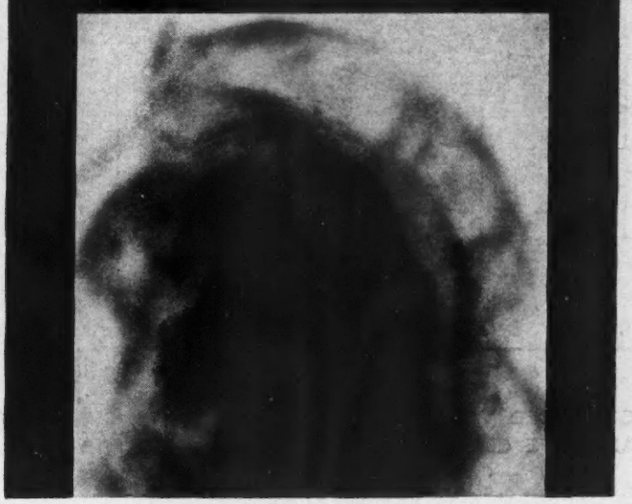

Crane recently added to their wide range a series of gate, globe and check valves in Forged Steel. These valves are designed for long service in severe working conditions. A varied trim selection makes them applicable to many different services, including chemicals of a corrosive nature, and steam at high pressures and temperatures up to 1,000 degrees F. Crane Forged Steel Valves are made with screwed or socket-welding ends to British and American Standards. Sizes range from ¼" to 2".

In common with all Crane products, these Forged Steel valves are made to extremely high standards and are subjected to careful inspection and individual testing at every stage. They are therefore completely dependable in situations where working conditions are arduous and long life is essential.

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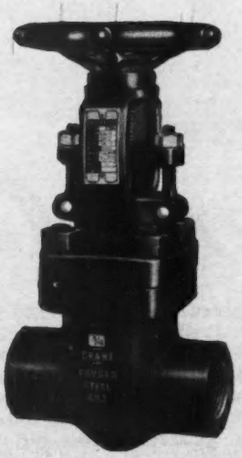

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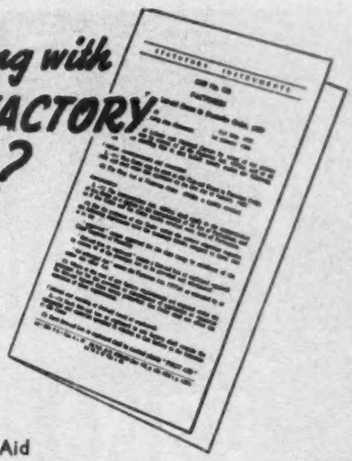

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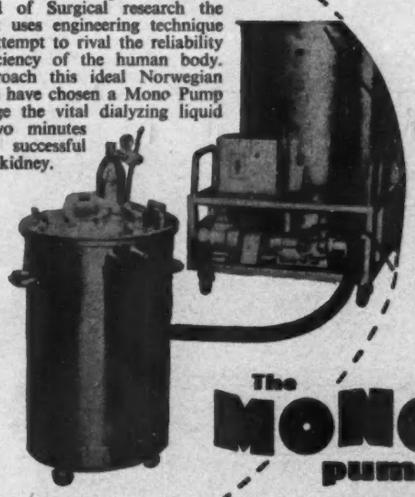

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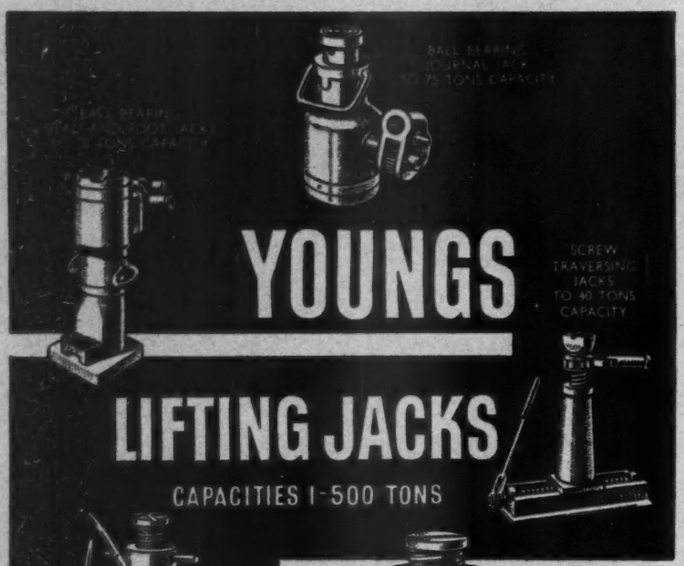
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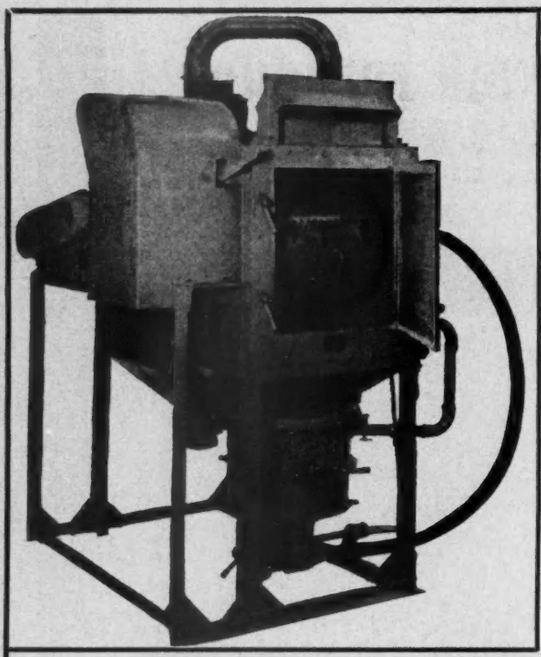

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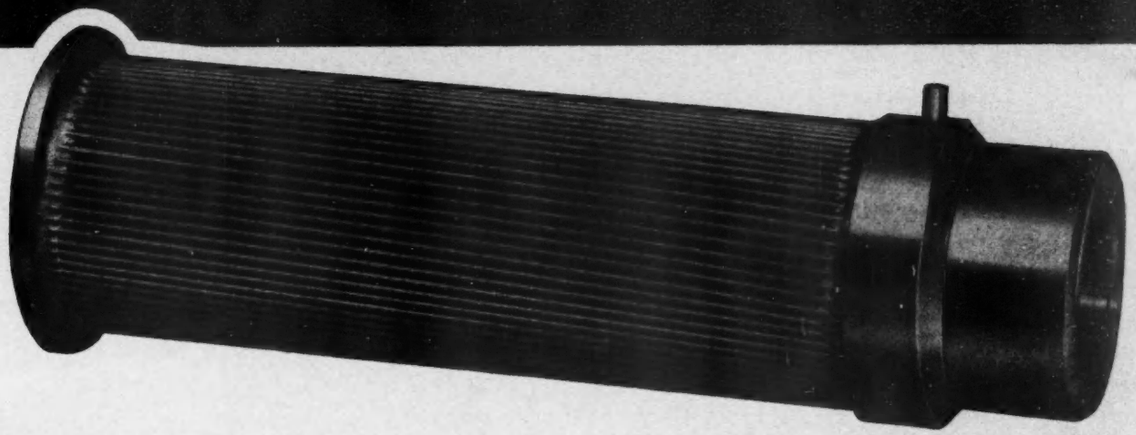

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The unique combination of properties found in Poroloy CM has led to its recent use in critical temperature conditions in the United States missile and aircraft industries, including installation in the Boeing 707.

POROLOY T.

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The illustration (above right) shows the many sizes and forms—seamless tubes, flat discs, corrugated elements etc.—in which Poroloy can be manufactured.

Both filter elements are manufactured in conditions of micro-cleanliness and before despatch are individually checked for performance in the bubble point testing equipment (right).

Poroloy was developed by the California Institute of Technology and is manufactured in the U.K. under license from the Bendix Aviation Corporation, U.S.A.

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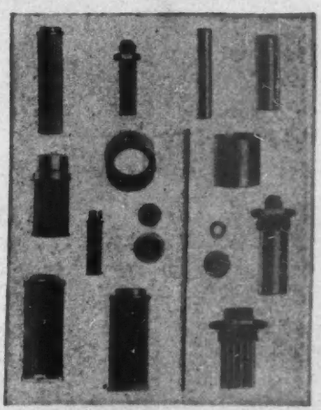

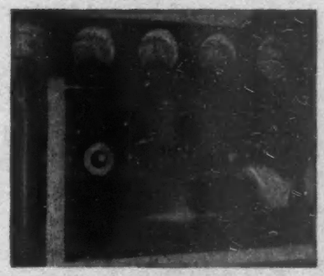

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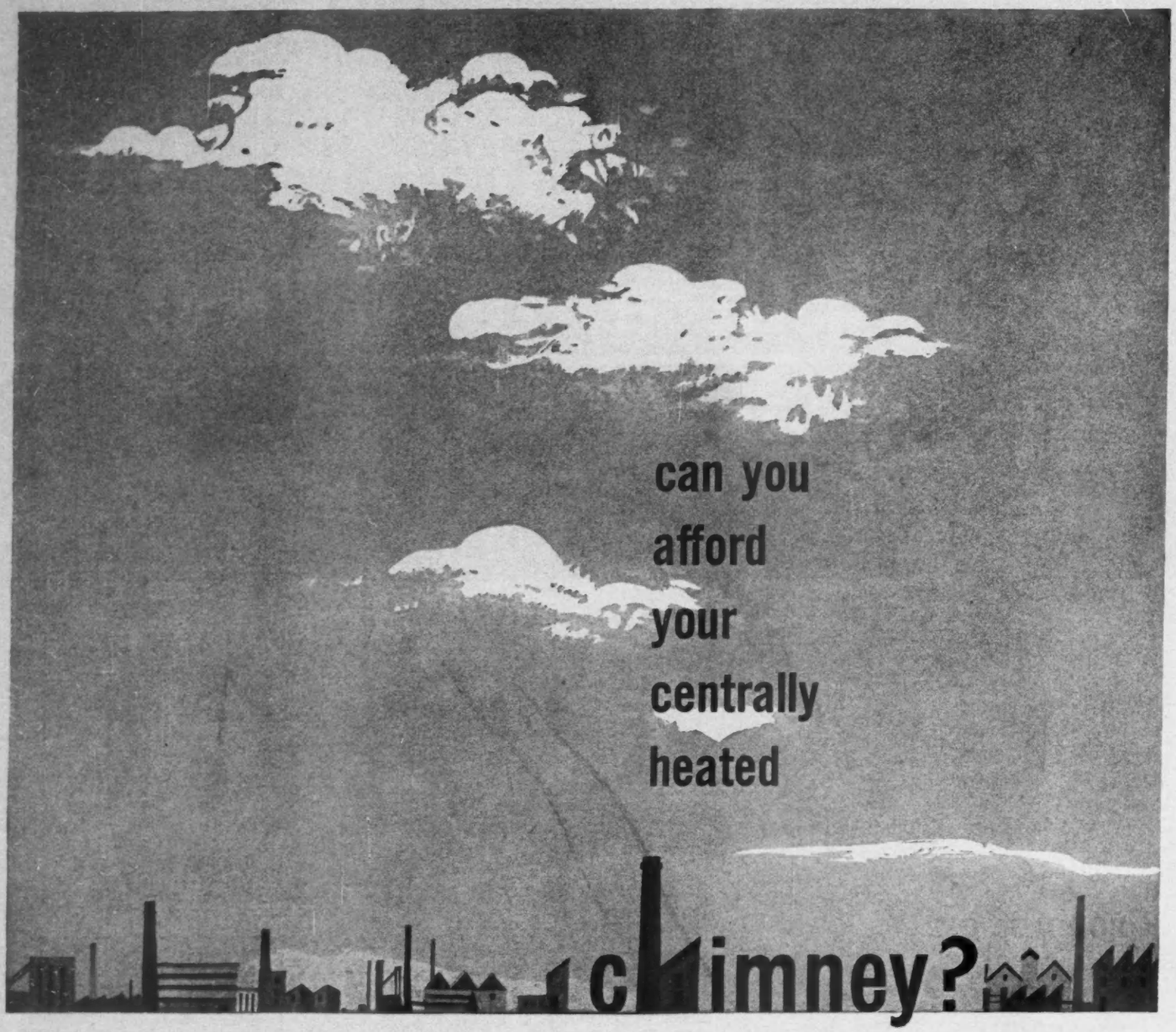

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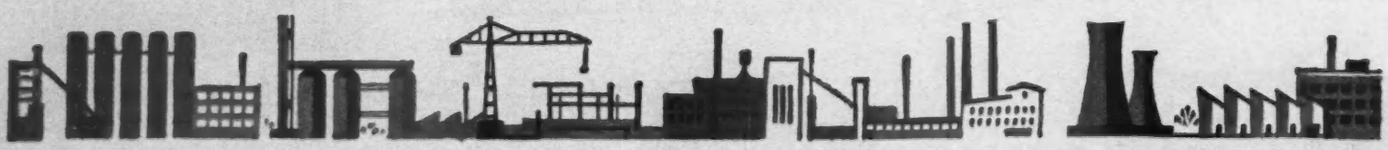

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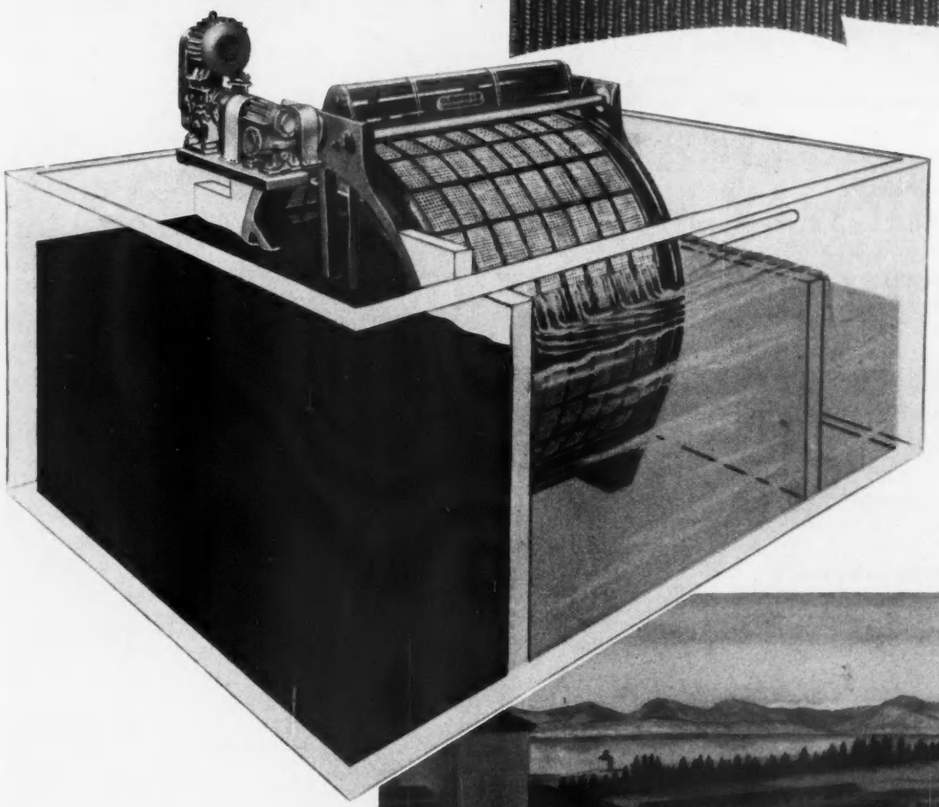
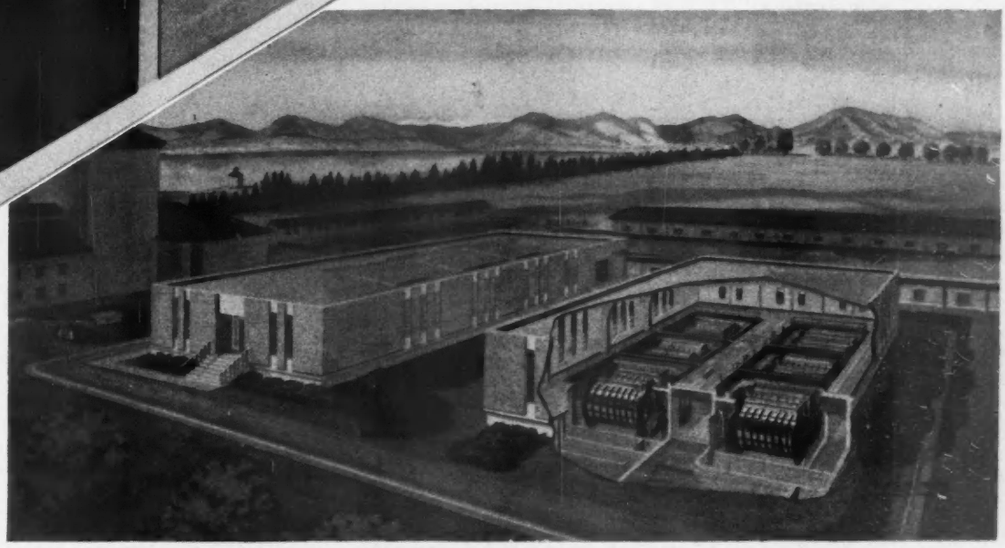
GLENFIELD MICRO-STRAINING



for water and effluent clarification



Courtesy R. B. McRae, Chief Engineer, Denver Water Board, Colorado

Micro-straining, the Glenfield filtration process for the removal of microscopic suspended matter from water and effluents by automatic mechanical means at low cost, is used to advantage by public utility and industrial concerns in many parts of the world.

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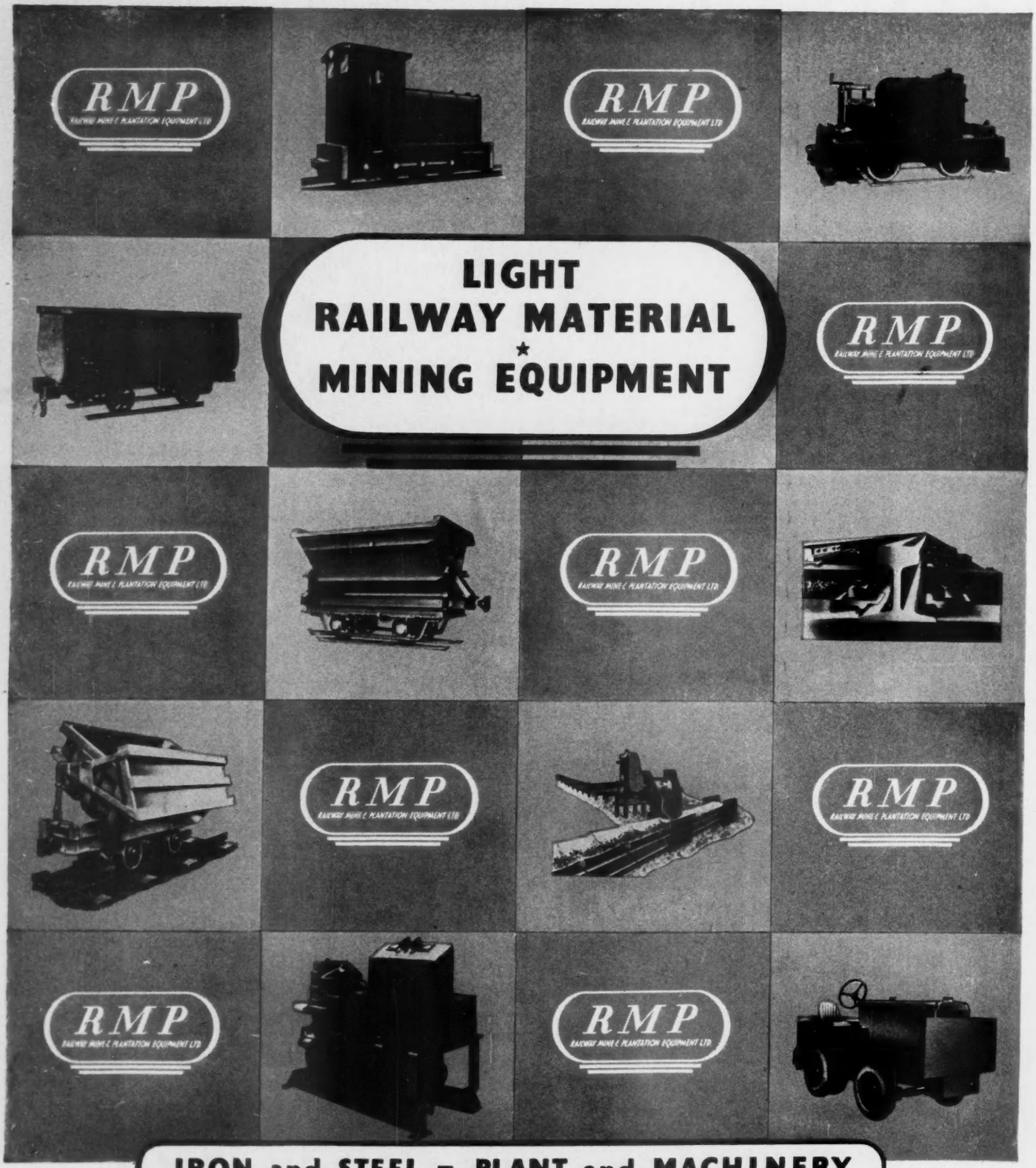
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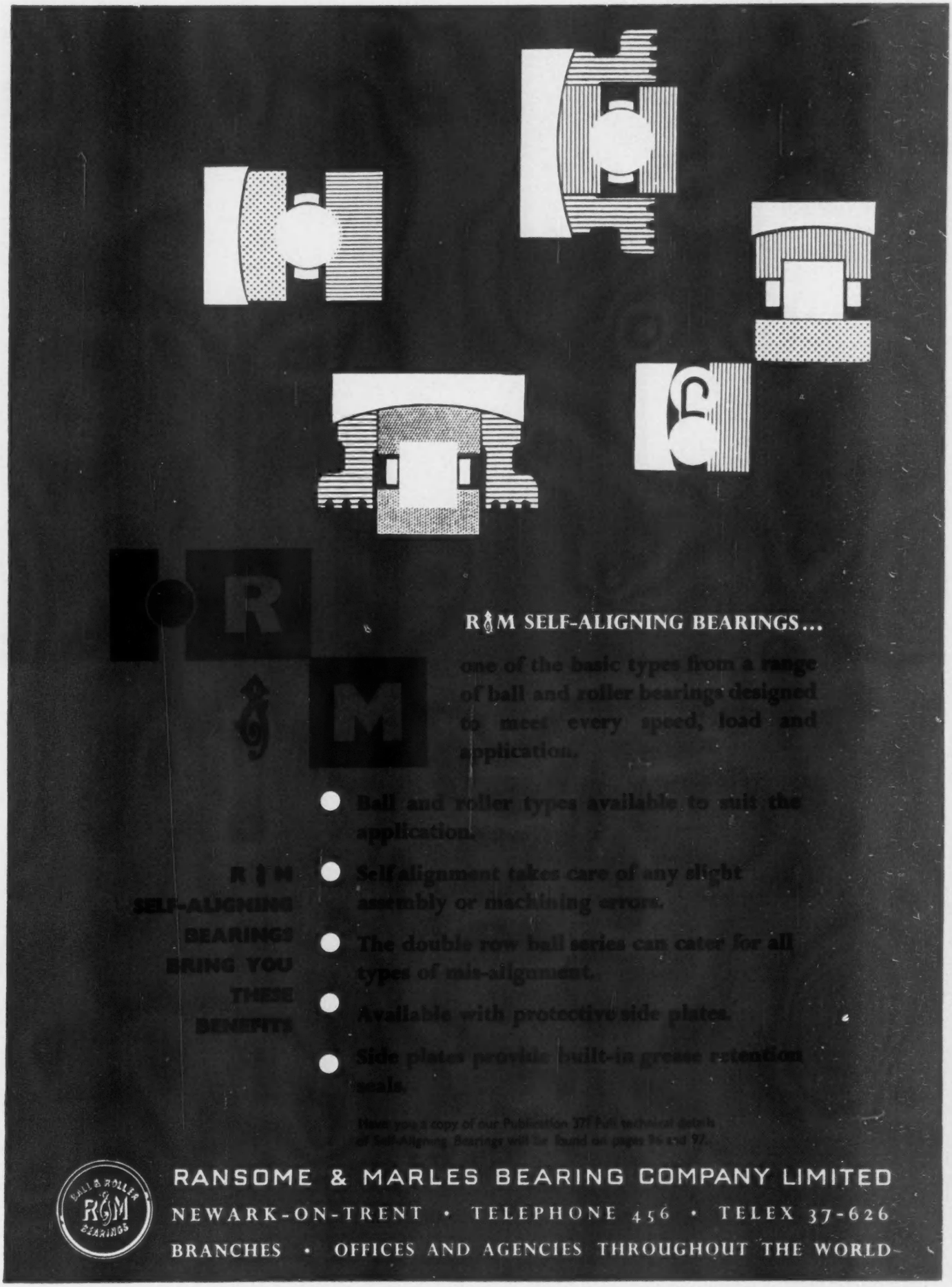
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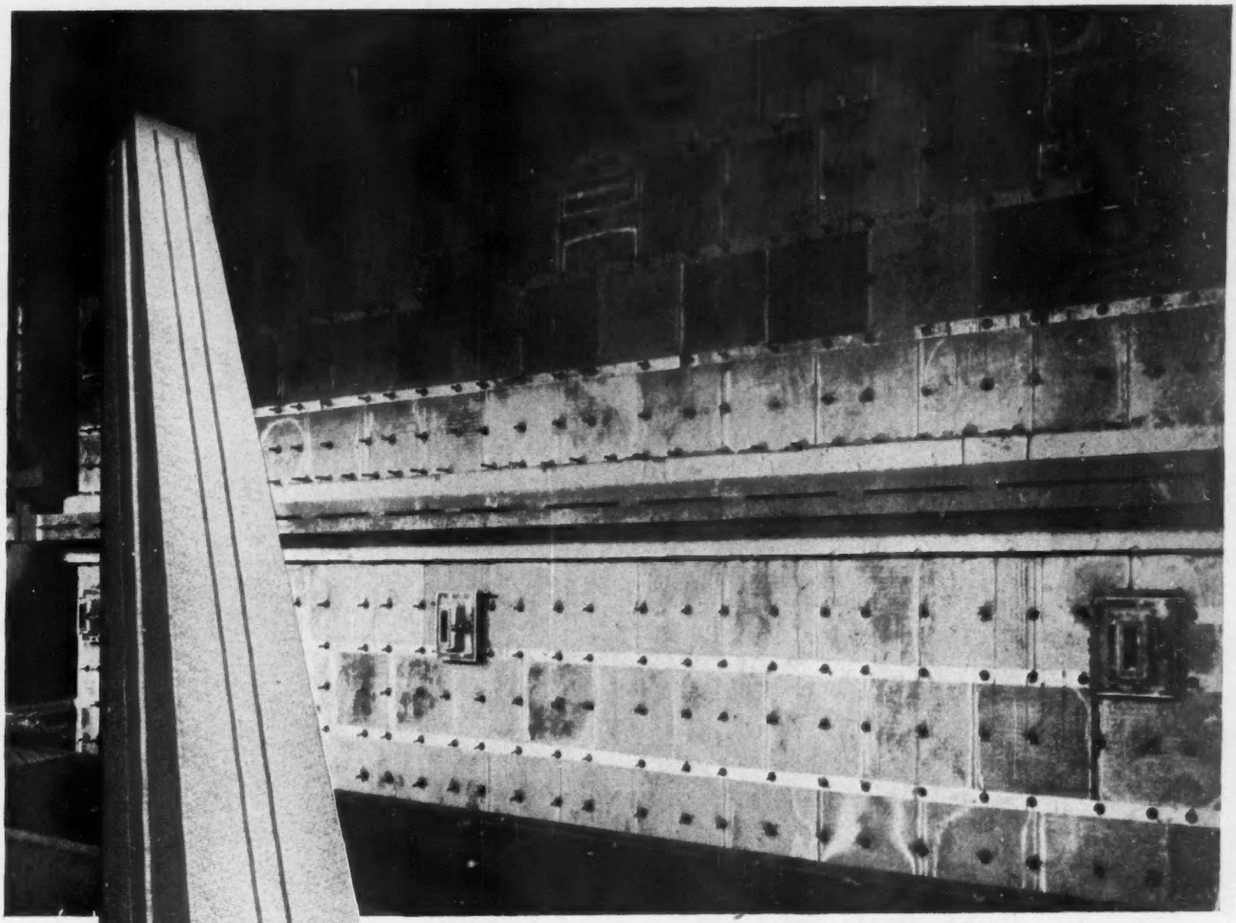

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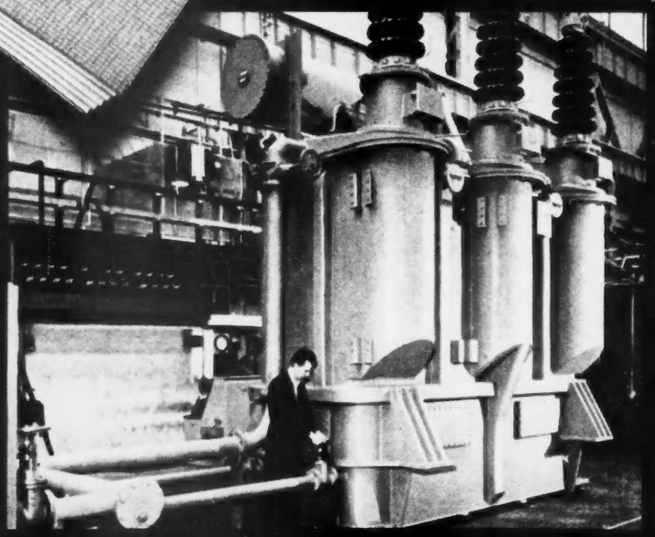

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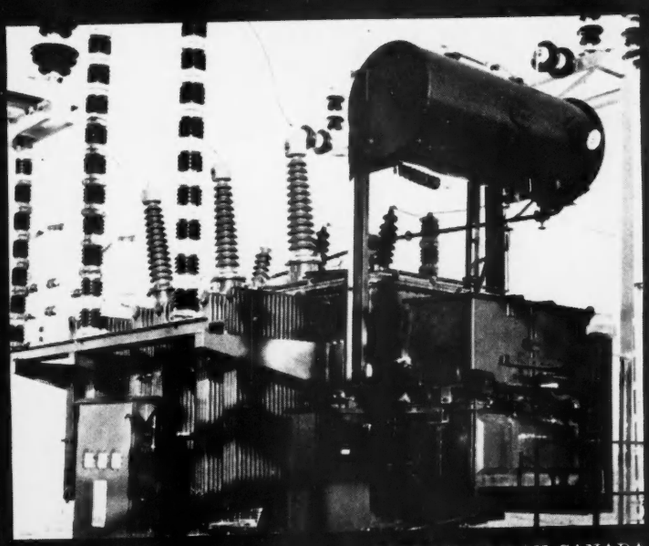

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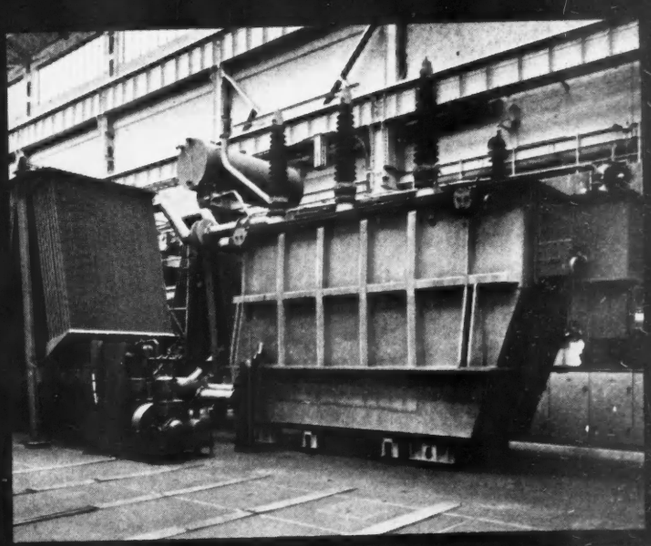

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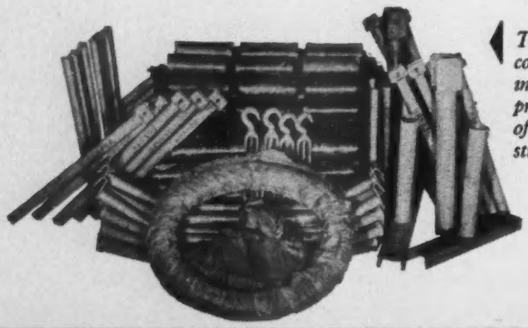

This group of components—stacked in an area of 28 sq. ft.—produce 200 ft. of this conveyor structure . . . .

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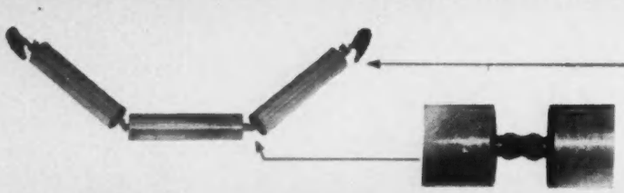
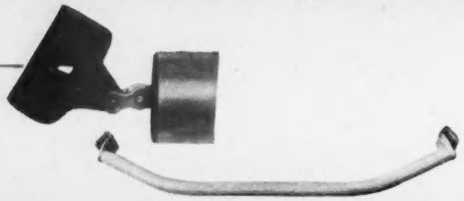
ROPE BELT

CONVEYOR STRUCTURE
patented



Swivel links are fitted at each end of an idler shaft



stretchers are used at intervals between stands

RESILIENT

—increases belt life
—reduces installation cost
—increases capacity
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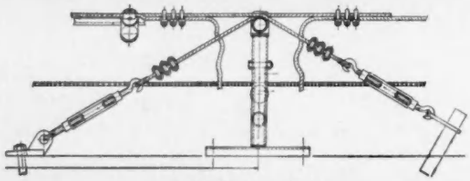
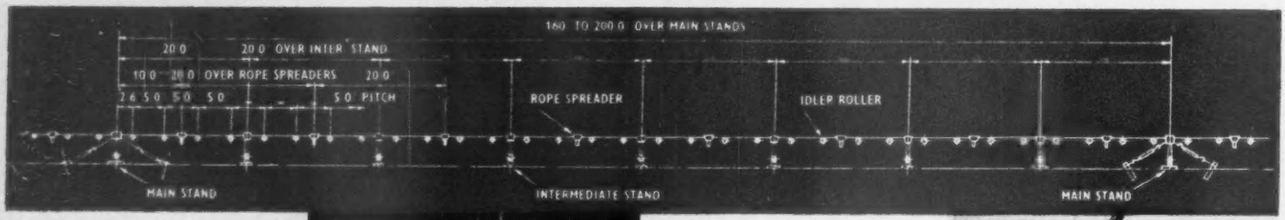
—is corrosion resistant

intermediate supporting stand

main supporting stand



typical rope anchorages


160 TO 200 0 OVER MAIN STANDS
20 0
20 0 OVER INTER STAND
10 0 20 0 OVER ROPE SPREADERS 20 0
2 6 5 0 5 0 5 0
5 0 PITCH
ROPE SPREADER
IDLER ROLLER
MAIN STAND
INTERMEDIATE STAND
MAIN STAND

Installation, extension and contraction of Distington-Goodman Rope Belt Conveyor Structure is relatively quick and easy.

(Right) Detail of a main stand and anchor point. These can be spaced up to 400' apart according to requirements.

A 36" rope belt conveyor installed at a quarry, carrying 500 tons of gravel per hour. By securing the rope to terminal pulleys it has proved practicable to move this conveyor bodily sideways by the dragline shown in the illustration.

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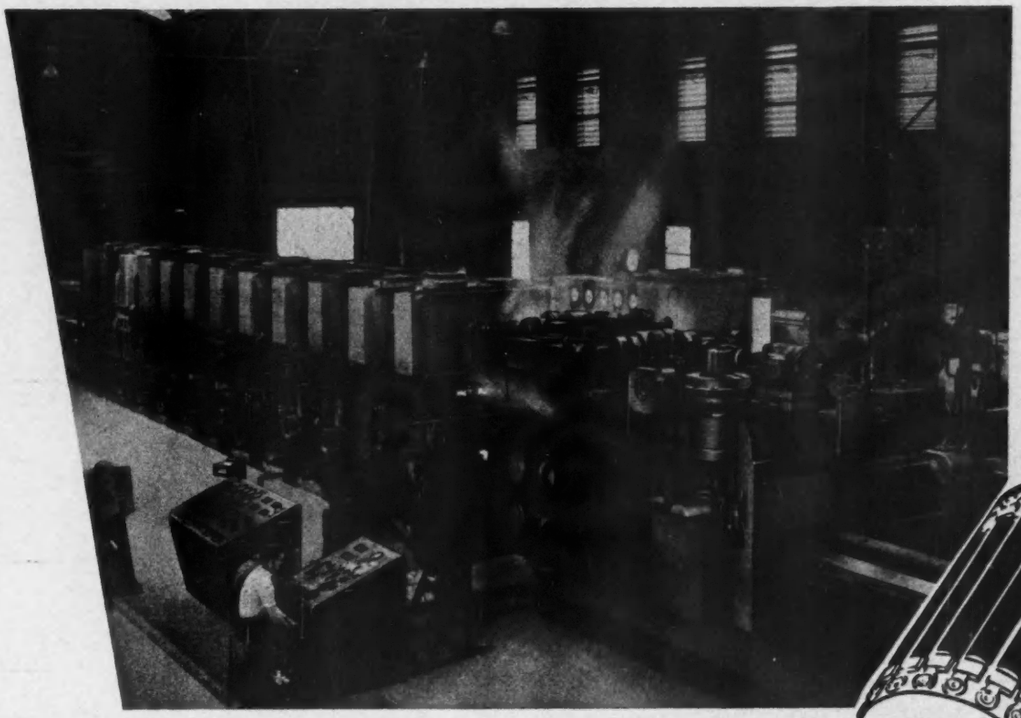

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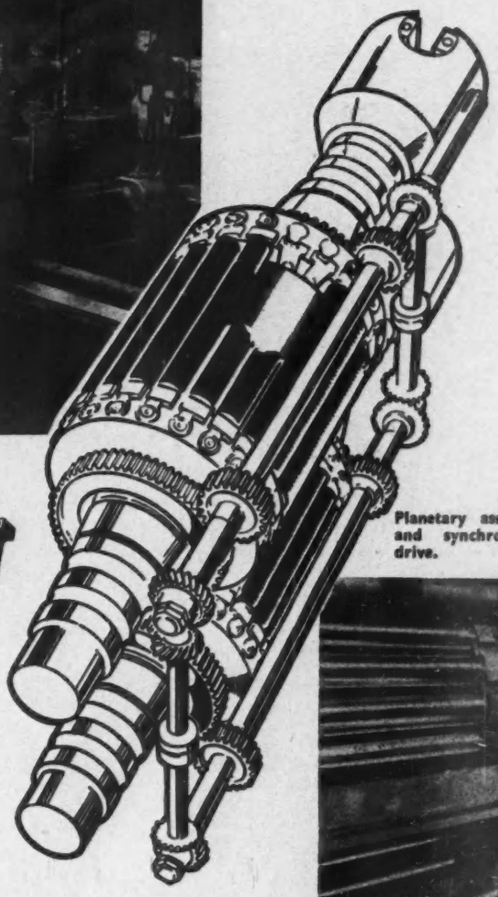

Planetary assembly and synchronizing drive.

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This mill is designed to produce hot rolled strip up to 15in. wide and as thin as 0·048in. from slabs 1¾in. thick in mild, high carbon and stainless steels.

The mill consists essentially of feed rolls, planetary roll assembly and a final two-high planishing mill followed by coiling equipment. Nominal output is 10 tons per hour which has already been considerably exceeded.

Surface finish is fully up to the standard required for subsequent cold rolling.

This is the second Planetary Mill in Great Britain both of which have been

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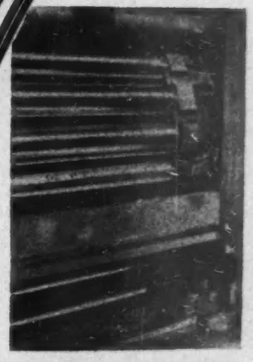

1

1. Planetary rolls seen from exit side.
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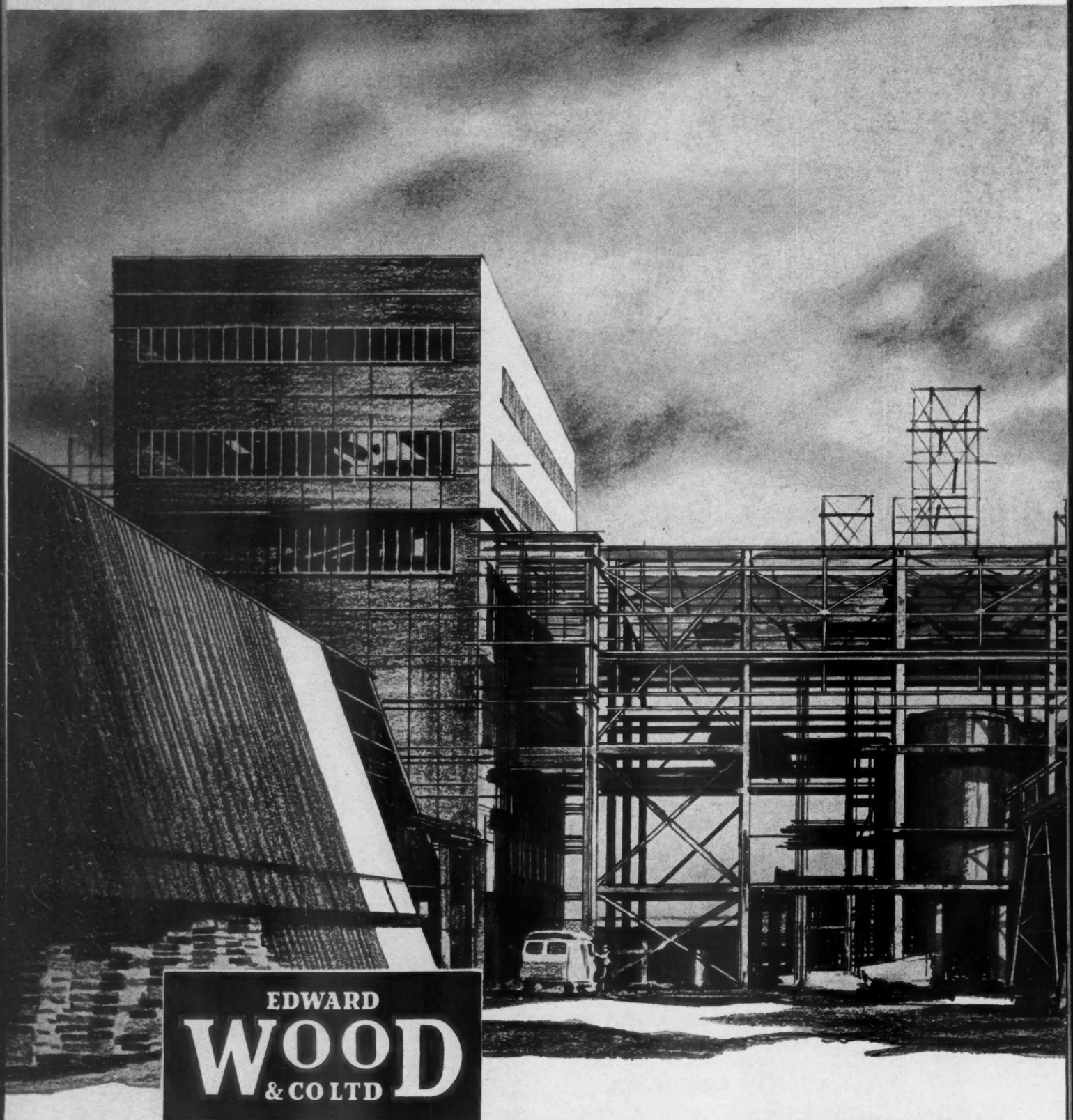

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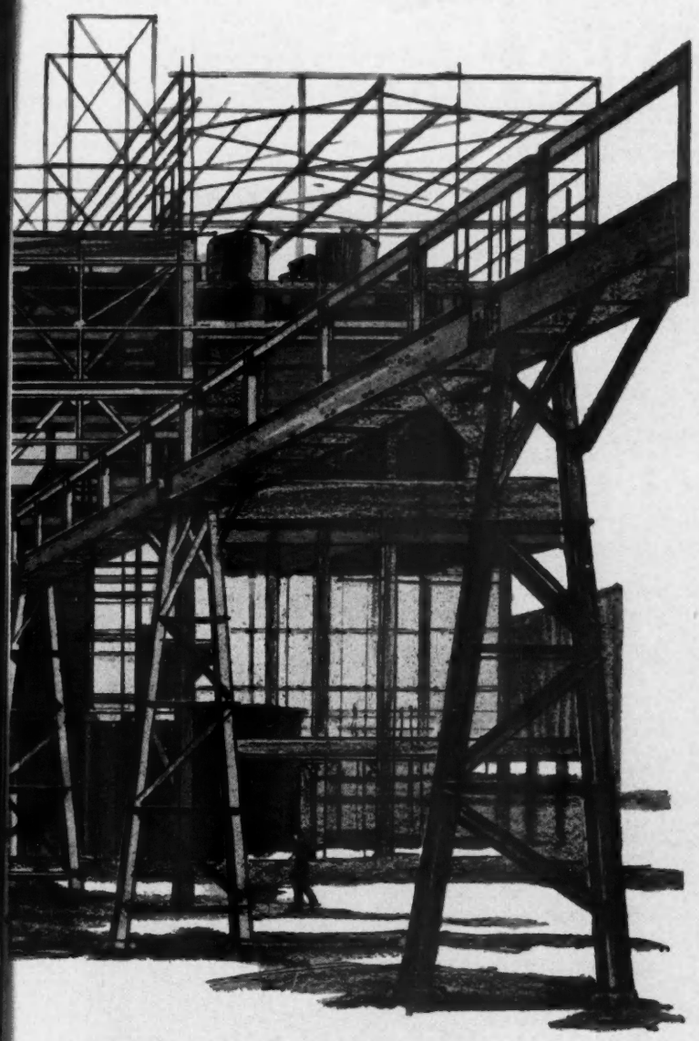

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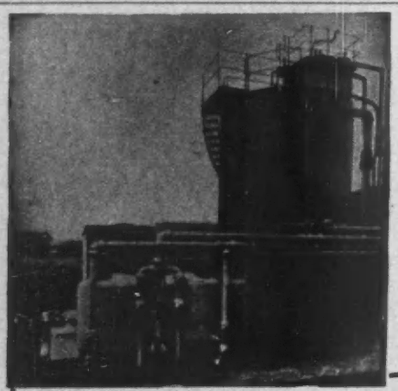

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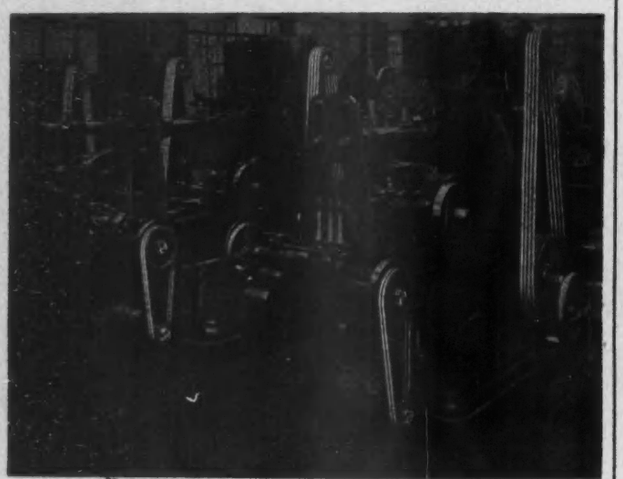

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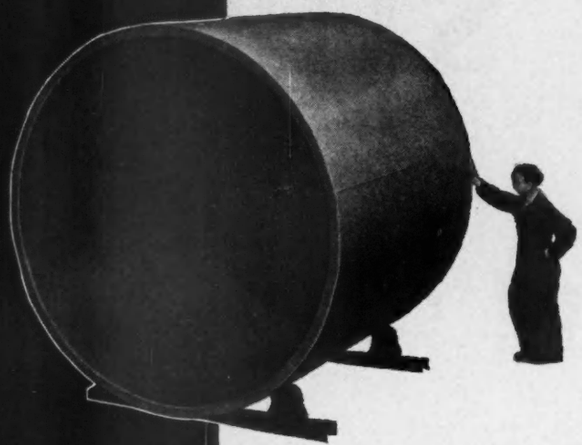

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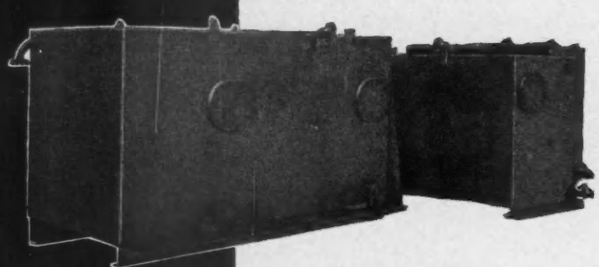

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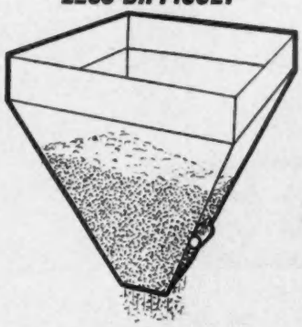

The installation of an external vibrator to a steel hopper.

trouble-free bunker discharge

The primitive, inefficient method commonly used for clearing material which sticks in a storage bunker is by applying a sledge hammer to the side of the hopper. This is a form of low frequency, uncontrolled vibration. When vibration is applied at the *correct* frequency, the *correct* amplitude and the *correct* point of application, almost any material can be satisfactorily discharged.

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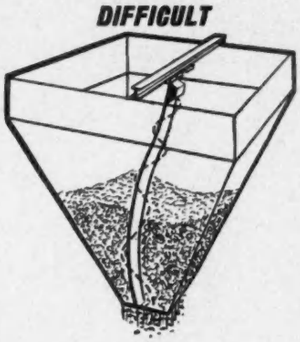
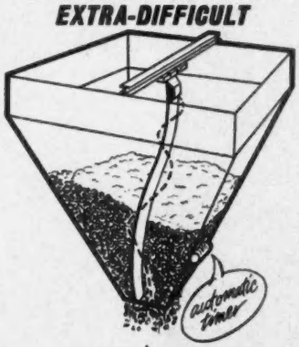


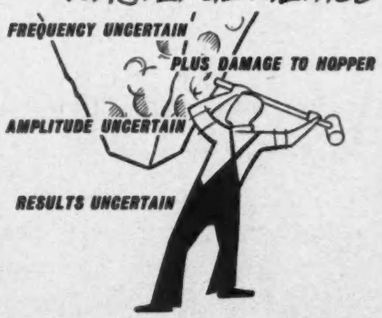
The vibrating reed for application where external vibration is impractical due to structural or other difficulties and if the bunker is made of concrete.

EXTRA-DIFFICULT



A combination of internal and external bunker vibration. Where the external vibrator is timed for 'on and off', the vibration frequency, on slowing down, goes through the natural resonance of the bunker, irrespective of load material contained.

ELIMINATE THIS WASTEFUL METHOD



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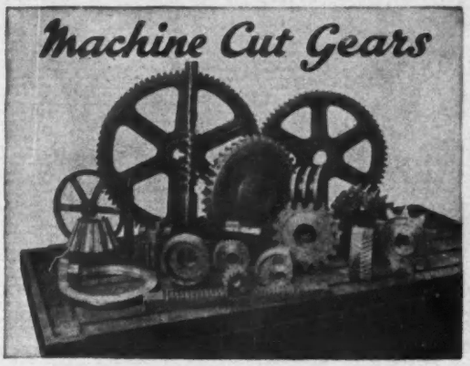

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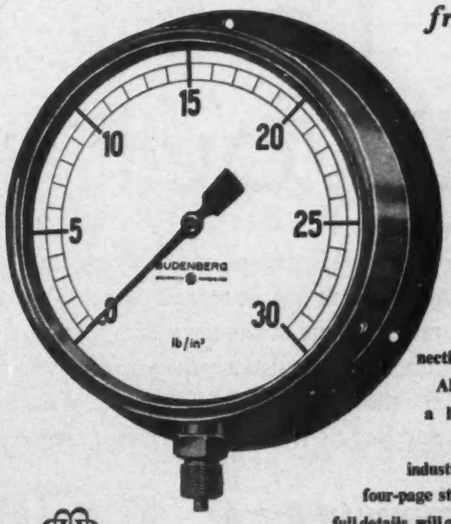

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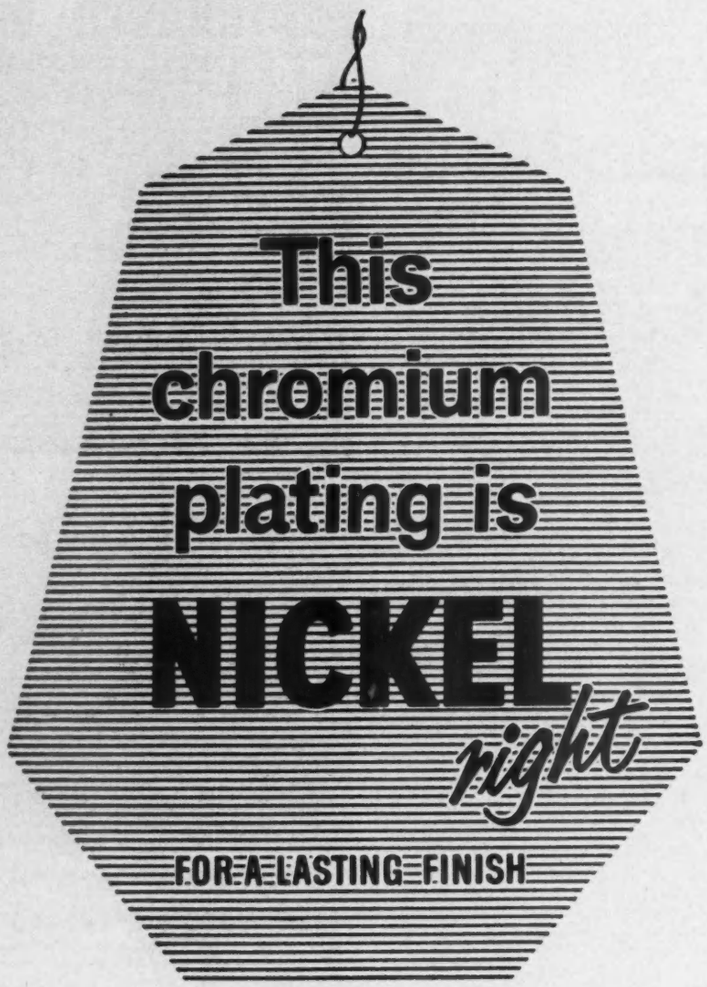

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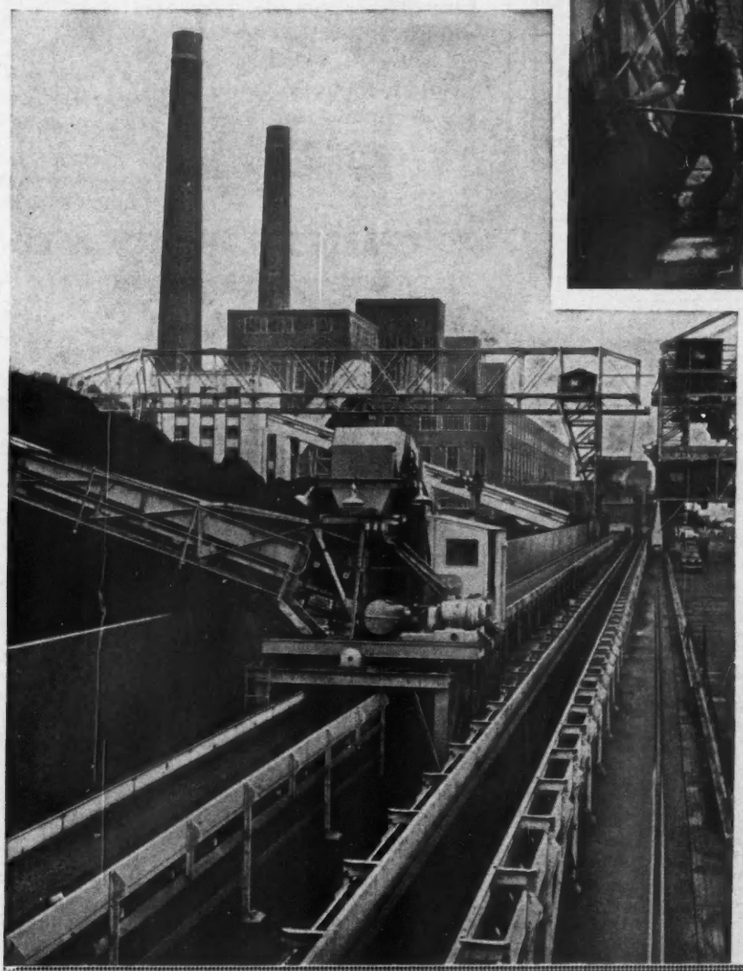

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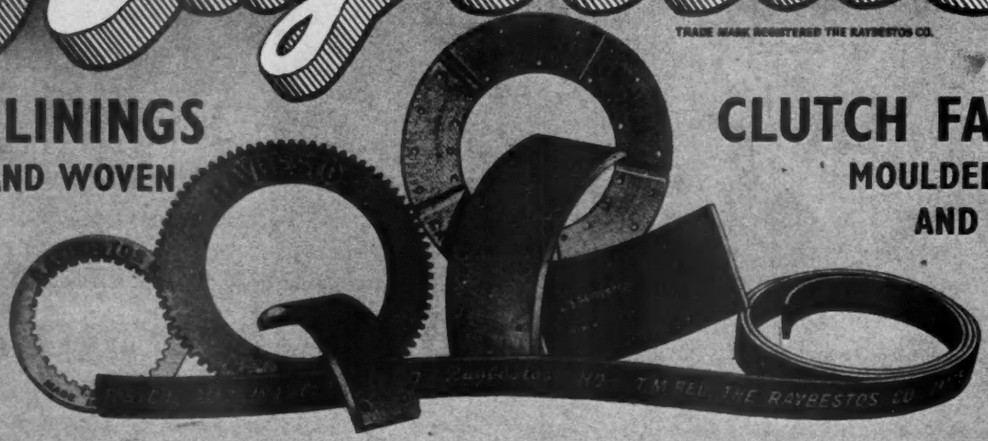

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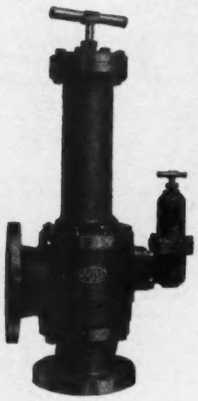

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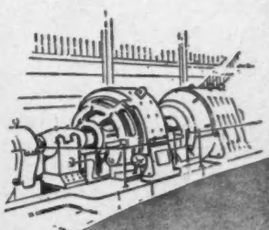

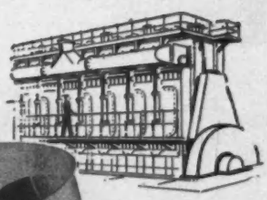

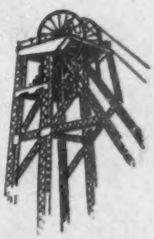

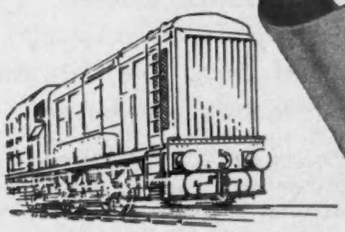

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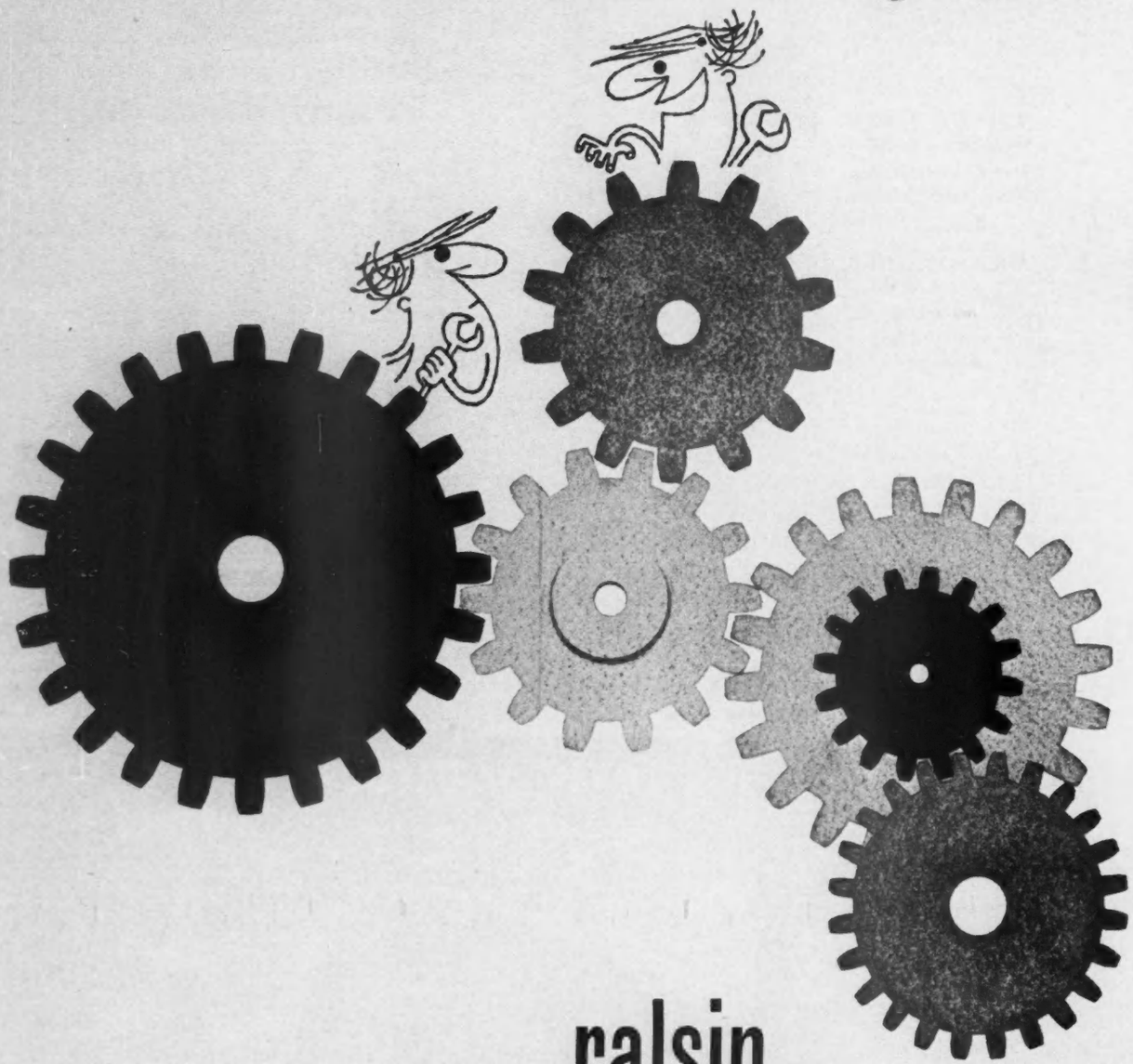

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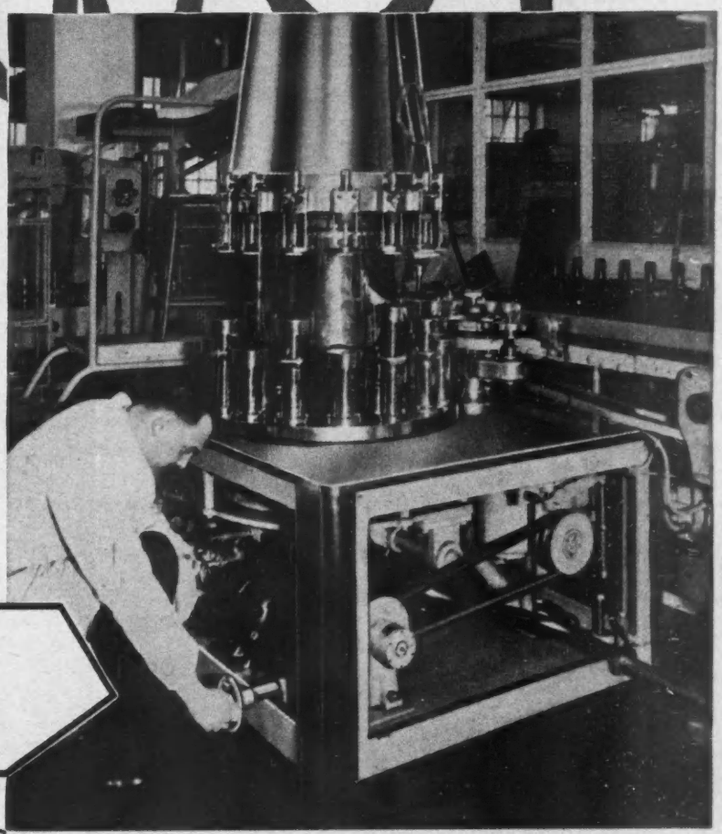

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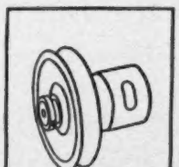

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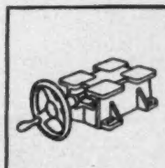

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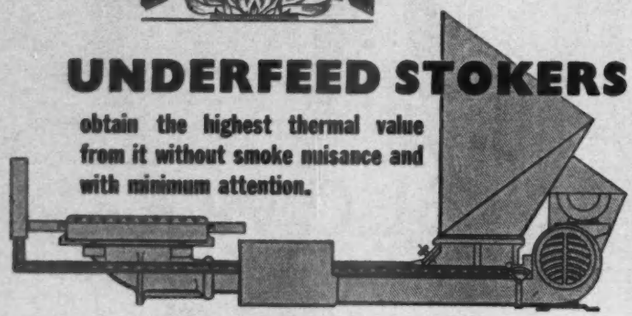

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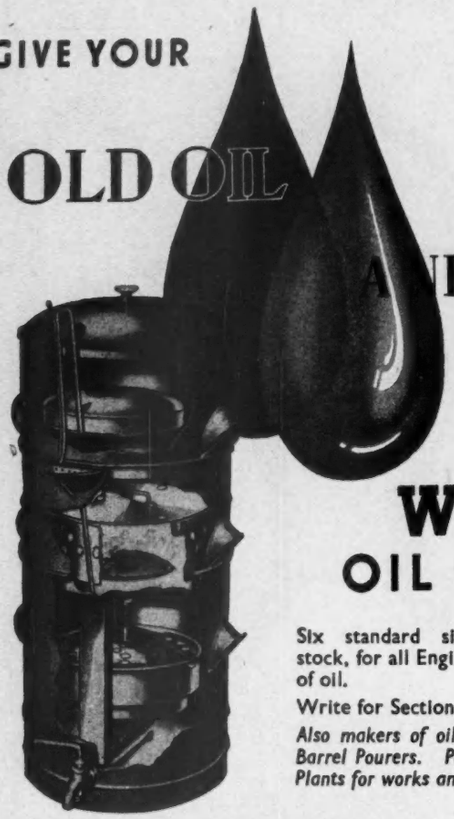

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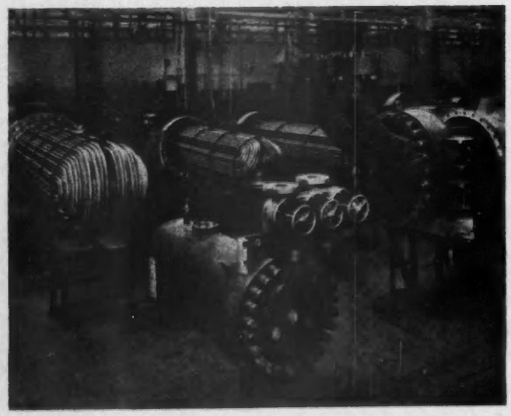

H & W solid drawn copper tubes used in construction of Weir Marine Feed Water Heaters. (Photograph by courtesy of Messrs. G. & J. Weir Limited.)

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Fitting "Hudal" aluminium brass tubes in Weir Three-stage Air Ejector for the liner "Reina del Mar". (Photograph by courtesy of Messrs. G. & J. Weir Limited.)

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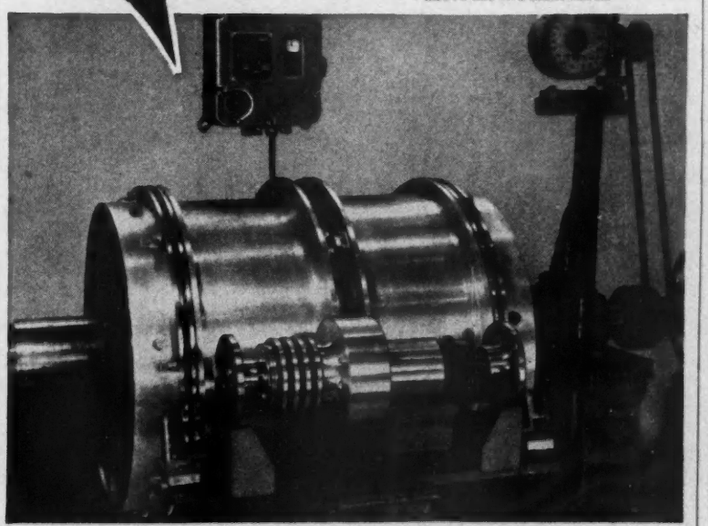

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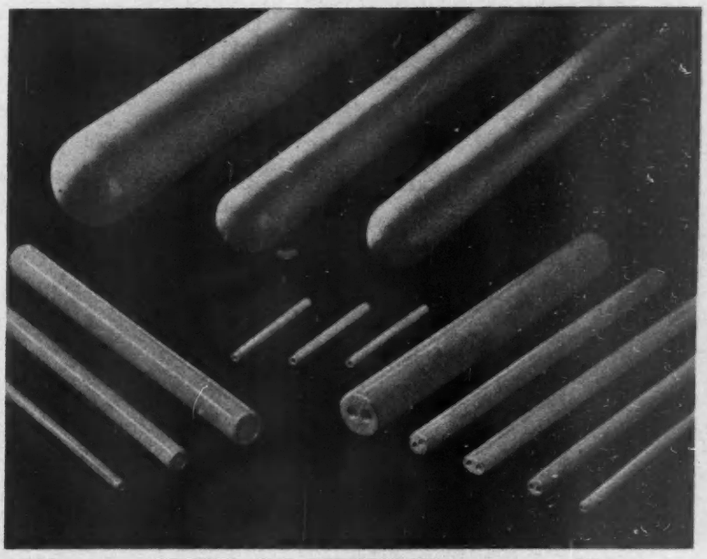

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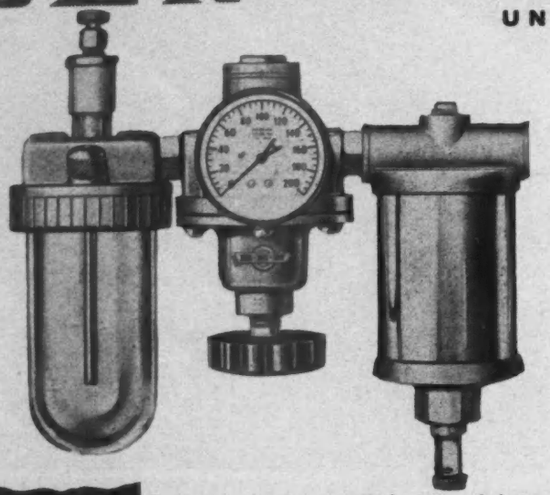

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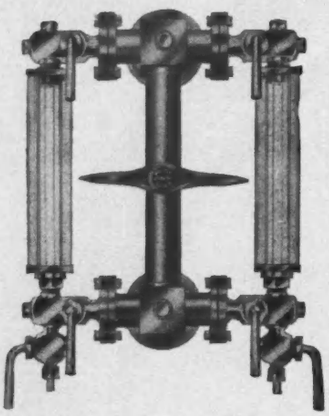

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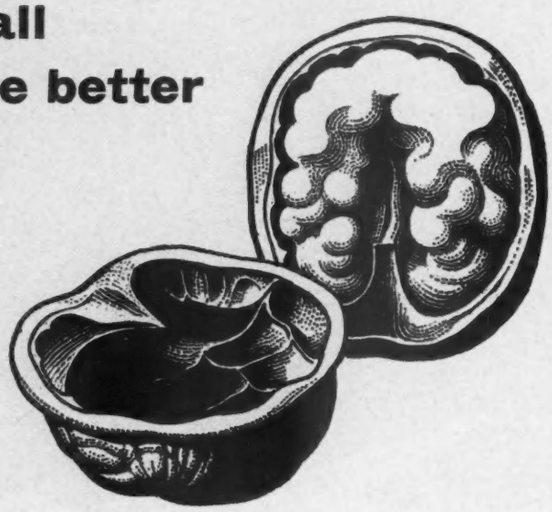

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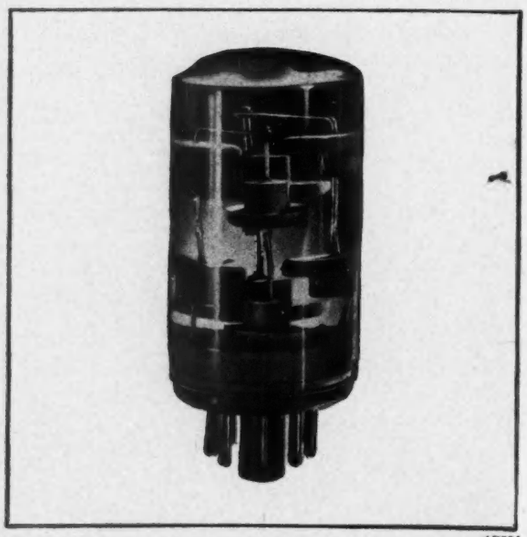

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